II Conferenza Nazionale Simpios

PULIZIA, ANTISEPSI E DISINFEZIONE IN AMBITO SANITARIO

Milano, 7 Novembre 2017

SIMPIOS

Le infezioni esogene e il ruolo dell'ambiente nella trasmissione delle ICA.

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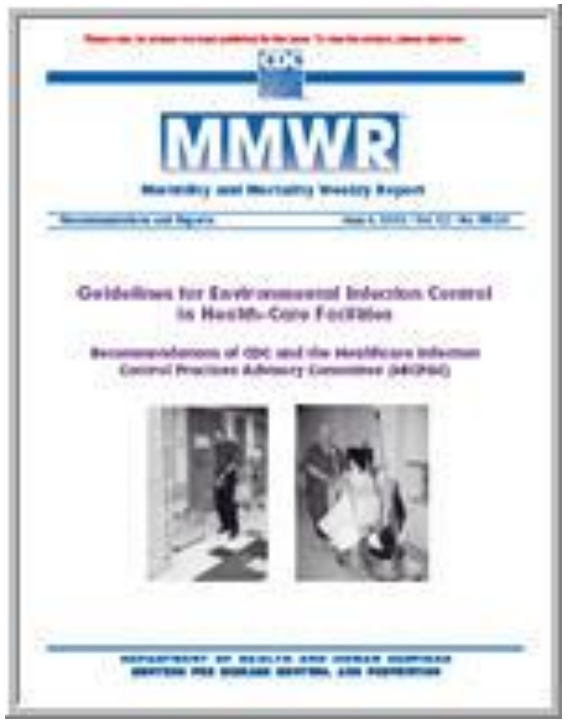

Guidelines for environmental infection control in health-care facilities

Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee - 2003

…The mere presence of a microorganism on an environmental surface does not confirm it as the cause of patient infection even if the same microbe is recovered from both. Rather, necessary steps involved in the ***"chain of cross-transmission" must be completed.***

American Journal of Infection Control 45 (2017) 170-9

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

State of the Science Review

Infection control in the new age of genomic epidemiology

Patrick Tang MD, PhD [a,*], Matthew A. Croxen PhD [b], Mohammad R. Hasan PhD [a,c], William W.L. Hsiao PhD [b,d], Linda M. Hoang MD [b,d]

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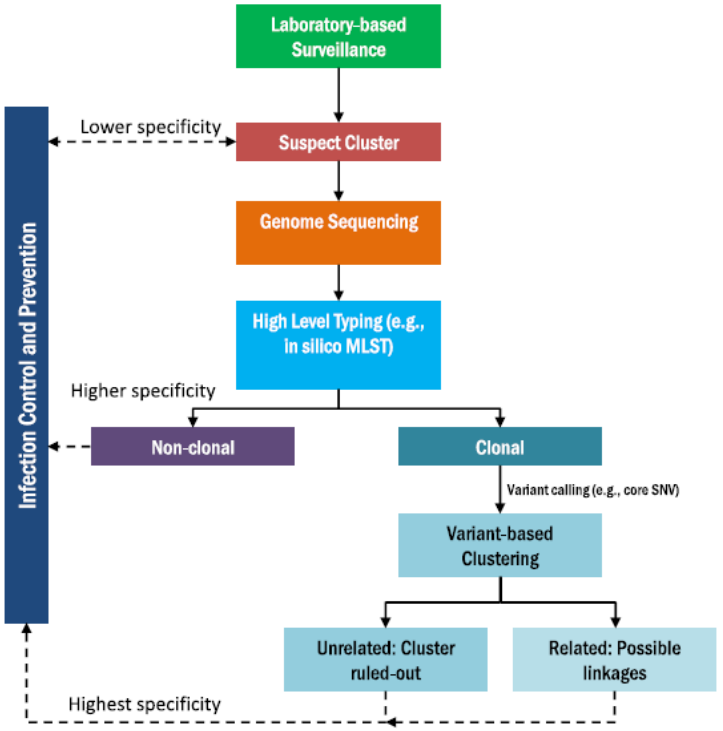
Key Words:
Whole-genome sequencing
Next-generation sequencing
Genomic epidemiology
Outbreak
Genotyping
Molecular epidemiology

With the growing importance of infectious diseases in health care and communicable disease outbreaks garnering increasing attention, new technologies are playing a greater role in helping us prevent health care–associated infections and provide optimal public health. The microbiology laboratory has always played a large role in infection control by providing tools to identify, characterize, and track pathogens. Recently, advances in DNA sequencing technology have ushered in a new era of genomic epidemiology, where traditional molecular diagnostics and genotyping methods are being enhanced and even replaced by genomics-based methods to aid epidemiologic investigations of communicable diseases. The ability to analyze and compare entire pathogen genomes has allowed for unprecedented resolution into how and why infectious diseases spread. As these genomics-based methods continue to improve in speed, cost, and accuracy, they will be increasingly used to inform and guide infection control and public health practices.

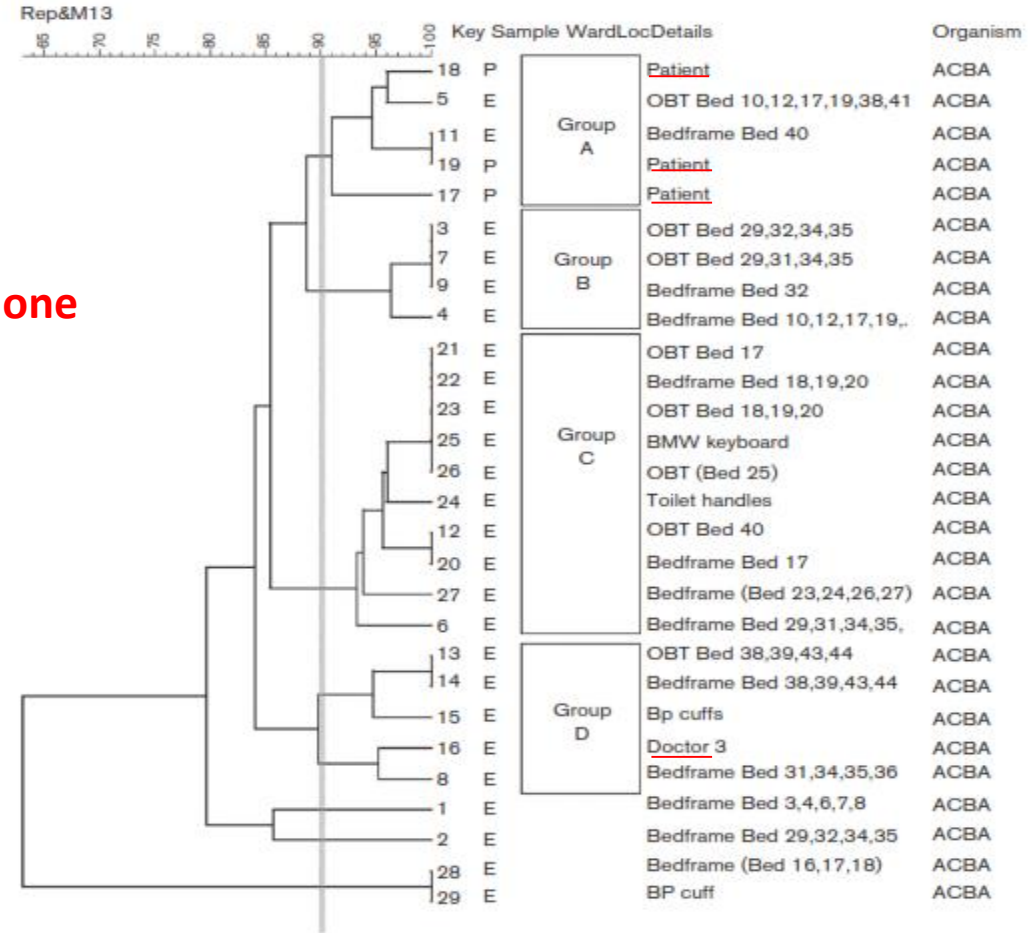


Journal of Medical Microbiology (2013), **62**, 766–772 DOI 10.1099/jmm.0.052860-0

Multidrug-resistant organisms in a routine ward environment: differential propensity for environmental dissemination and implications for infection control

Thean Yen Tan,[1] Jasmine Shi Min Tan,[2] Huiyi Tay,[2] Gek Hong Chua,[3] Lily Siew Yong Ng[1] and Nur Syahidah[4]

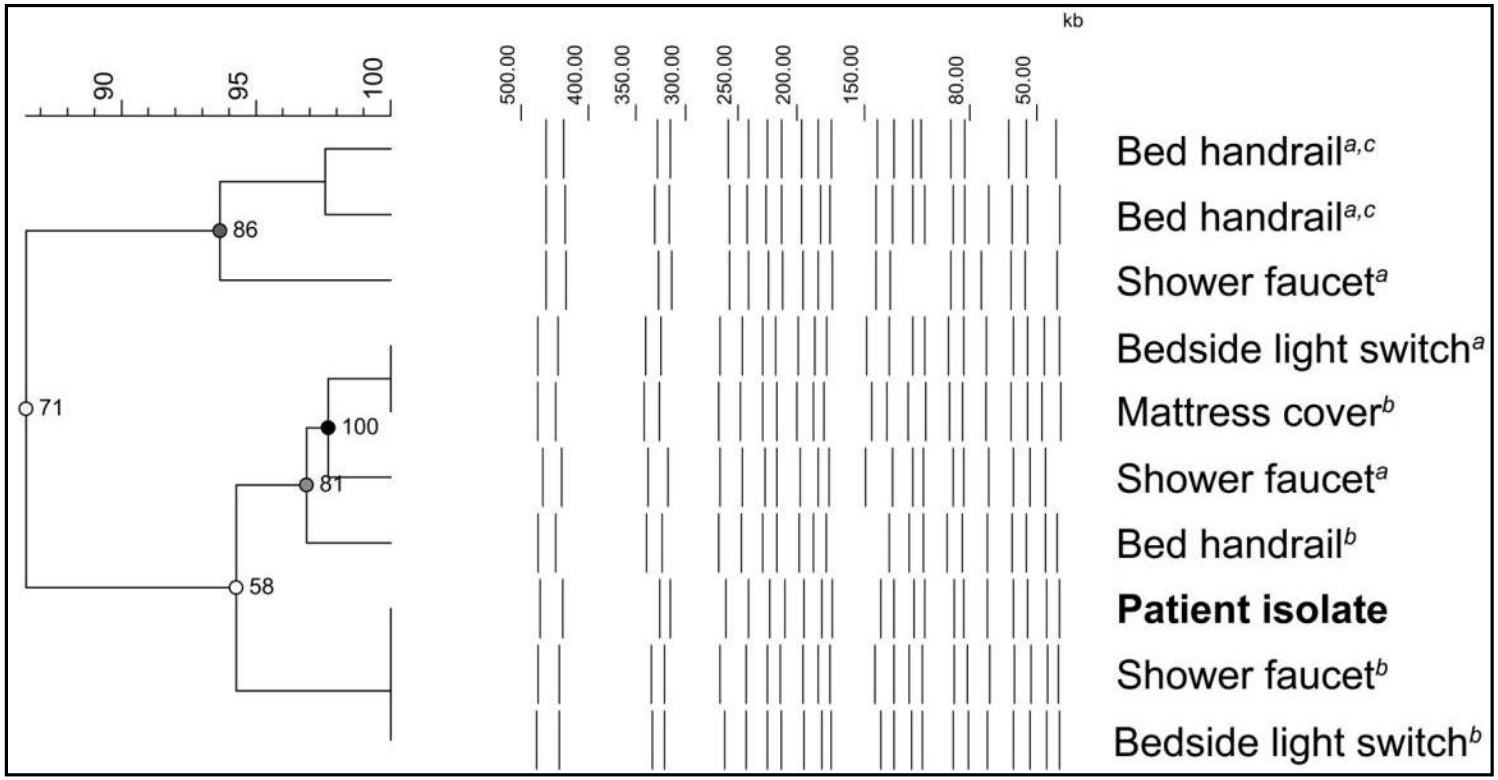
Fig. 2. Molecular typing of CR *A. baumannii* isolates.



La genotipizzazione per dimostrare la relazione tra contaminazione ambientale-paziente-operatore sanitario

Molecular typing demonstrated the presence of related strains **in patients and in the environment (Group A)** and on the **hands of healthcare workers and environment (Group D).**

Search and You Will Find: Detecting Extended-Spectrum β-Lactamase–Producing *Klebsiella pneumoniae* from a Patient's Immediate Environment



INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MAY 2013, VOL. 34, NO. 5

Le superfici inanimate.

Otter et al American Journal of Infection Control 41 (2013) S6-S11

- Environmental surfaces were once thought to play a negligible role in the endemic transmission of nosocomial pathogens.
- However, recent data indicate that contaminated surfaces play an important role in the endemic and epidemic transmission of certain pathogens that cause health care-associated infections.
- Clostridium difficile, MRSA, VRE, norovirus, and multidrug-resistant (MDR) gram-negative rods including Acinetobacter baumannii share the ability to be shed from infected or colonized patients, survive on dry surfaces for extend periods, and are difficult to eradicate by cleaning and disinfection.
- Whereas the role of contaminated surfaces in the transmission of some pathogens such as the spore-forming C difficile has been recognized for some time, the importance of contaminated surfaces in the transmission of other pathogens such as MDR A baumannii has come to light only in recent years.
- The continued emergence of antimicrobial resistance in gram-negative bacteria in particular means that effective prevention and control strategies are required urgently.

Transmission of healthcare-associated pathogens **most frequently occurs via the transiently contaminated hands of healthcare workers**[1,2], but **environmental surfaces such as medical equipment and housekeeping surfaces (hand-touch sites) may also contribute to the spread of pathogens**[1,3-12].

It's just as easy to pick up microbes from the environment as it is from patient

(Carling and Bartley; AJIC 2009)

John M. *Infect Control Hosp Epidemiol* 2009; 30:678-684.
Siegel JD *Am J Infect Control* 2007; 35:S65–S164.
Samore MH *Am J Med* 1996; 100:32–40.
Hayden MK *Clin Infect Dis* 2006; 42:1552–1560.
Hayden MK *Infect Control Hosp Epidemiol* 2008; 29:149–154.
Martınez JA *Arch Intern Med* 2003; 163:1905–1912.
Huang SS *Arch Intern Med* 2006; 166:1945–1951.
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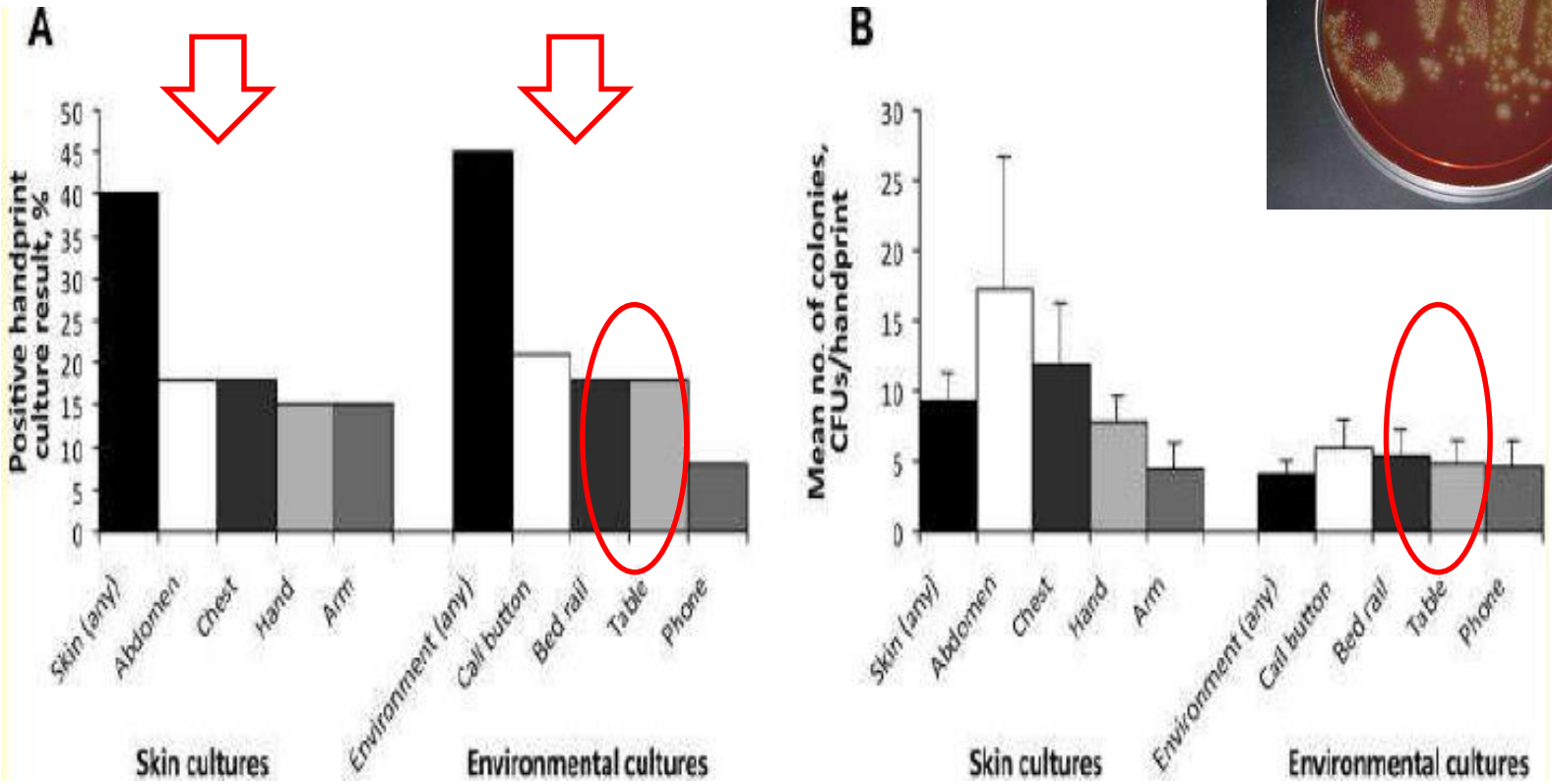
Wu HM *Infect Control Hosp Epidemiol* 2005; 26:802–810.
Dancer SJ *J Hosp Infect* 1999; 43:85–100.
Moore G *Infect Control Hosp Epidemiol* 2013;34:500-6
Otter J *Am J Infect Control* 2013; 41: S6-S11

Le mani del personale sanitario si contaminano per contatto con il paziente o con le superfici ambientali?



La contaminazione delle mani con MRSA è simile dopo il contatto con il paziente (40% colture positive) e il contatto con le superfici ambientali (45%). Stiefel et al., ICHE 2011

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY MAY 2013, VOL. 34, NO. 5

The Type, Level, and Distribution of Microorganisms within the Ward Environment: A Zonal Analysis of an Intensive Care Unit and a Gastrointestinal Surgical Ward

Moore G, Muzslay M, Wilson AP.

Il personale sanitario e i pazienti contribuiscono entrambi alla contaminazione dell'ambiente

TABLE 3. Distribution of Potential Pathogens within an Intensive Care Unit

Sample zone	Surfaces from which target organisms were recovered, %				
	MSSA	MRSA	VSE	VRE	Gram-negative rods[a]
5-bed bay					
Patient bed (zone 1; n = 65)	3	0	6	0	6
Near-patient environment (zone 2; n = 420)	4.5	0.7	6	0	7
Wider bed space (zone 3; n = 294)	4	0.7	6	0.3	21
Wider bay environment (zone 4; n = 198)	5.5	0.5	5	0	6
Wider ward environment (zone 5; n = 66)	4.5	0	3	1.5	4.5
Staff toilet (zone 6; n = 124)	6.5	3	5	0	16
Clinical information station (zone 7; n = 164)	11	2	0.6	0	3
Single isolation room					
Patient bed (zone 1; n = 33)	3	18	21	0	15
Near-patient environment (zone 2; n = 324)	4	7	9	0	5
Wider room environment (zone 3; n = 132)	2	5	3	0	18
Outside single room (zone 4; n = 165)	4	0.6	2	0	1

NOTE. MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S. aureus*; VRE, vancomycin-resistant enterococci; VSE, vancomycin-susceptible enterococci.

[a] Including *Acinetobacter baumannii*.

Sampling was conducted in and around the bed space of 166 different patients

Surfaces located closest to the patient, specifically those associated with the bed (side rails, bed control, and call button), were the most heavily contaminated.

In the ICU, bacteria were most likely to be on surfaces that were regularly **touched by healthcare workers** (e.g., telephones and computer keyboards).

In the GI ward, where the patients were mobile, the highest numbers of bacteria (including potential nosocomial pathogens) were on surfaces that were mainly touched by patients, particularly their toilet and shower facilities.

Journal of Medical Microbiology (2013), **62**, 766–772 DOI 10.1099/jmm.0.052860-0

Multidrug-resistant organisms in a routine ward environment: differential propensity for environmental dissemination and implications for infection control

Thean Yen Tan,[1] Jasmine Shi Min Tan,[2] Huiyi Tay,[2] Gek Hong Chua,[3] Lily Siew Yong Ng[1] and Nur Syahidah[4]

MRSA (74%), CR *A. baumannii* (29 %) and ESBL *K. pneumoniae* (1 %)

Table 1. Environmental recovery of MDROs from sampled surfaces

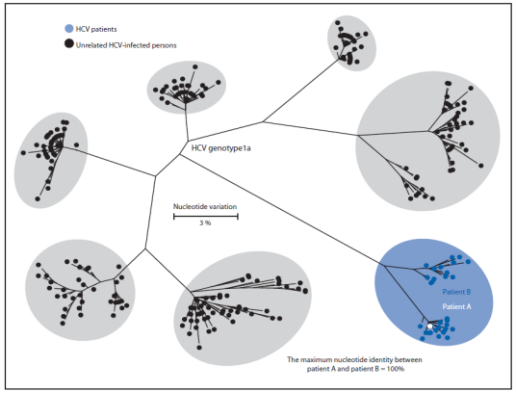
	Area	Surface	No. samples	MRSA		CR *A. baumannii*		VRE		Ceph-R *Klebsiella* spp.*	
				Positive (%)	Organism density (c.f.u. cm^{-2})	Positive (%)	Organism density (c.f.u. cm^{-2})	Positive (%)	Organism density (c.f.u. cm^{-2})	Positive (%)	Organism density (c.f.u. cm^{-2})
1.	Immediate patient environment	All sampled areas	50	82	0.42	40	0.47	4	0.29	–	–
		Bed frame	25	88	0.41	48	0.47	8	0.29	–	–
		Overbed table	25	76	0.44	32	0.46	–	–	–	–
2.	Commonly used equipment	All sampled areas	13	62	0.83	15	0.31	–	–	–	–
		Glucometer	2	50	1.54	–	–	–	–	–	–
		Stethoscope	6	67	0.64	–	–	–	–	–	–
		BP cuff	5	60	0.84	40	0.31	–	–	–	–
3.	Commonly touched surfaces	All sampled areas	19	63	0.59	10	0.11	–	–	–	–
		Bedside medical computer	6	100	0.37	17	0.11	–	–	–	–
		Door handle	7	43	0.87	14	0.12	–	–	14	0.35
		Telephone	6	50	0.76	–	–	–	–	–	–
		All sites	82	74	0.51	29	0.42	2	0.29	1	0.29

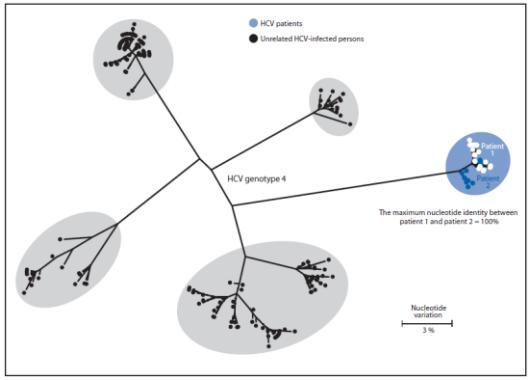
*Ceph-R, third-generation cephalosporin resistant.

MRSA è ampiamente diffuso nell'ambiente e sui dispositivi medici, mentre CR *A. baumannii* è prevalente sulle superfici più prossime al paziente.

Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 64 / No. 7
February 27, 2015

Transmission of Hepatitis C Virus Associated with Surgical Procedures — New Jersey 2010 and Wisconsin 2011





- **What is already known on this topic?**
  - **Hepatitis C virus (HCV) transmission documented in health care settings has been primarily a result of unsafe injection practices including reuse of needles, fingerstick devices, and syringes, and other breaches in infection control.**
- **What is added by this report?**
  - **Two separate occurrences of health care–associated HCV transmission likely resulted from breaches of infection prevention practices during surgical procedures. In one case, two patients received injectable propofol from the same medication cart; in the other, two patients received kidneys that had been perfused on the same machine. Molecular analyses of HCV strains helped epidemiologic investigators identify the source of transmission.**

Contents lists available at ScienceDirect

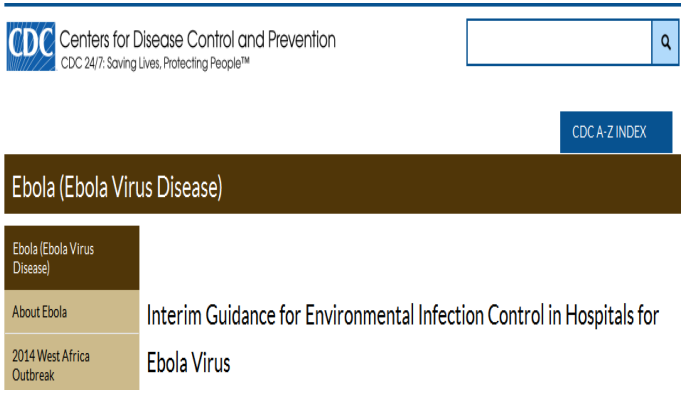
American Journal of Infection Control

journal homepage: www.ajicjournal.org

Commentary

Nebraska Biocontainment Unit patient discharge and environmental decontamination after Ebola care

Katelyn C. Jelden BS[a], Shawn G. Gibbs PhD[a,b], Philip W. Smith MD[b,c], Michelle M. Schwedhelm MSN[b,d], Peter C. Iwen PhD[e], Elizabeth L. Beam MSN[b,f], A. Kim Hayes RN[g], Nedra Marion MPA[g], Christopher J. Kratochvil MD[h], Kathleen C. Boulter BA[b], Angela L. Hewlett MD[b,c], John J. Lowe PhD[a,b,*]



Centers for Disease Control and Prevention

CDC 24/7: Saving Lives, Protecting People™

CDC A-Z INDEX

Ebola (Ebola Virus Disease)

Ebola (Ebola Virus Disease)

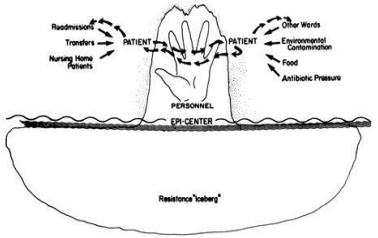
About Ebola

2014 West Africa Outbreak

Interim Guidance for Environmental Infection Control in Hospitals for Ebola Virus

- **EVD is transmitted by contact with infected blood or bodily fluids with an infectious dose of <10 viruses and high virus concentrations in blood 10^8 virus particles/mL**
- **Although negative for virus by molecular testing (quantitative polymerase chain reaction [qPCR] assay), discharged NBU patients successfully treated for EVD are at risk of touching EVD contaminated surfaces within the patient room and may serve as a disease vector to areas outside of isolation on discharge from the unit.**
- **Additionally, EVD patient remains are infectious and require safe and respectful infection control measures.**
- **To manage risks posed by EVD, the NBU uses infection control protocols that guide all steps of patient release, removal of patient remains, waste disposal, and systematic environmental decontamination that involves waste removal, surface cleaning, and multiple steps of disinfection.**

C.J. Donskey / American Journal of Infection Control 41 (2013) S12-S19



Isolation Room Surfaces

1

2

Exposure

Known Infection or Colonization

Portable Equipment

Hands of Healthcare Personnel

Susceptible Patient

Antibiotic pressures

4

Unidentified Carrier

Skin, Bedding, and Clothing

3

Everything you touch….

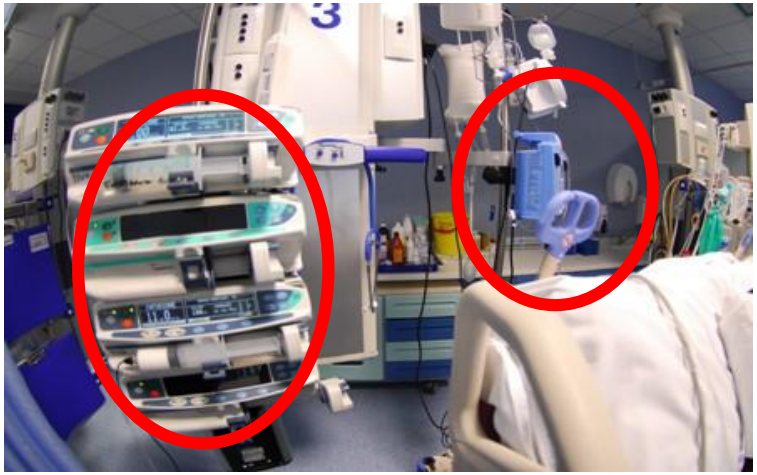
hand-touch sites

Le dita del personale sanitario (500 soggetti) sono risultate positive per MRSA:

6% dopo il contatto con il paziente
7% dopo contatto con le superfici ambientali
4% dopo un contatto non specifico
3% dopo gel alcolico
8% dopo lavaggio asettico (clorexidina)
3% dopo il lavaggio sociale
5% senza alcun lavaggio

Creamer et al, JHI 2010.

Punti critici:



la sanificazione degli elettromedicali

I dispositivi ad uso promiscuo

Gli operatori esterni e gli strumenti comuni (RX, Ecografi, Endoscopi…)

American Journal of Infection Control 43 (2015) 286-8

Contents lists available at ScienceDirect

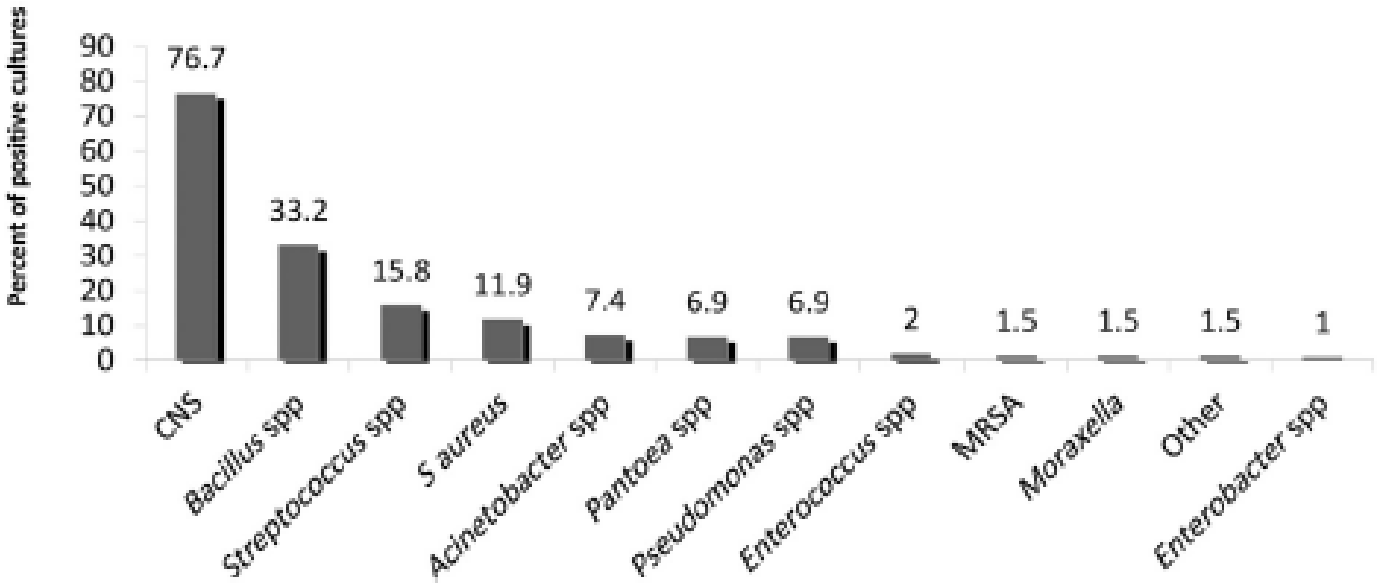
American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief report

Use of portable electronic devices in a hospital setting and their potential for bacterial colonization

Amber Khan MD [a,b,*], Amitha Rao MD [c], Carlos Reyes-Sacin MD [d], Kayoko Hayakawa MD, PhD [e], Susan Szpunar PhD [f], Kathleen Riederer MT [f], Keith Kaye MD, MPH [b,g], Joel T. Fishbain MD [h], Diane Levine MD [a,b]



American Journal of Infection Control xxx (2014) 1-3

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Brief report

Effectiveness of stringent decontamination of computer input devices in the era of electronic medical records and bedside computing: A randomized controlled trial

Shlomi Codish MD[a,b,c,*], Ronen Toledano BmedSc[a,b], Victor Novack MD, PhD[a,b], Michael Sherf MD, MPH[b,c], Abraham Borer MD[b,c,d]

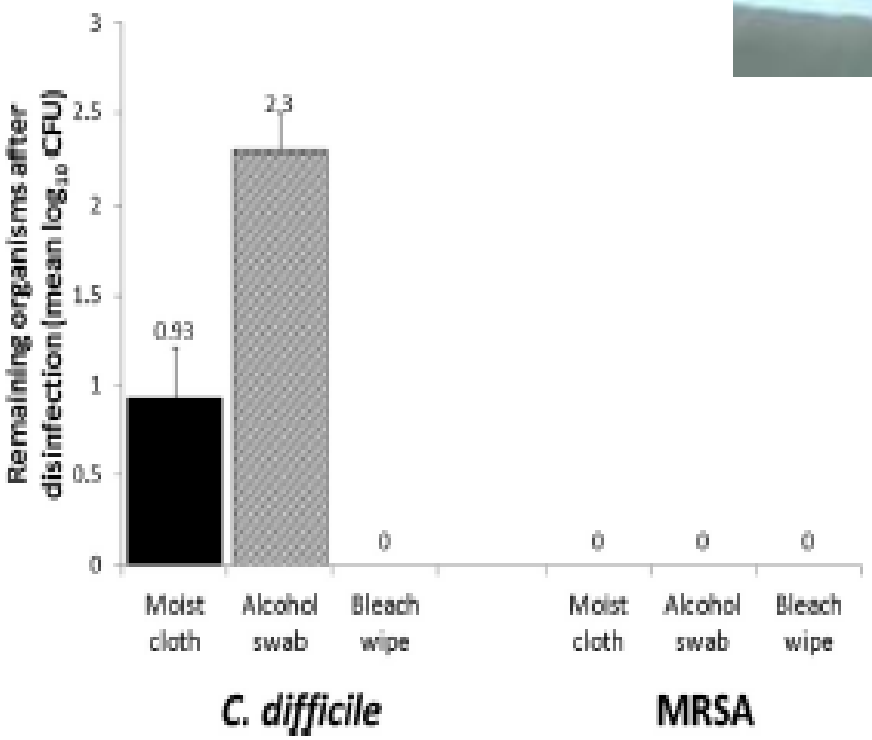
- **Bedside computing may lead to increased hospital-acquired infections mediated by computer input devices handled immediately after patient contact.**
- **We compared 2 decontamination methods in 2 types of wards.**
- **We found high baseline contamination rates, which decreased following decontamination, but the rates remained unacceptably high.**
- **Decontamination was more effective in intensive care units compared with medical wards and when using alcohol-based impregnated wipes compared with quaternary ammonium-based impregnated wipes**

American Journal of Infection Control xxx (2013) 1-2

Letter to the editor

Disinfection of iPad to reduce contamination with *Clostridium difficile* and methicillin-resistant *Staphylococcus aureus*

To the Editor:



3 su 20 (15%) IPad sono risultati positivi per *C.difficile* o GRAM-, nessuno per *S.aureus*

Efficacia di differenti metodi di disinfezione (IPad artificialmente contaminati)

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY NOVEMBER 2016, VOL. 37, NO. 11

ORIGINAL ARTICLE

Healthcare Personnel Attire and Devices as Fomites: A Systematic Review

Nicholas Haun, MD;[1] Christopher Hooper-Lane, MA;[2] Nasia Safdar, MD, PhD[3,4]

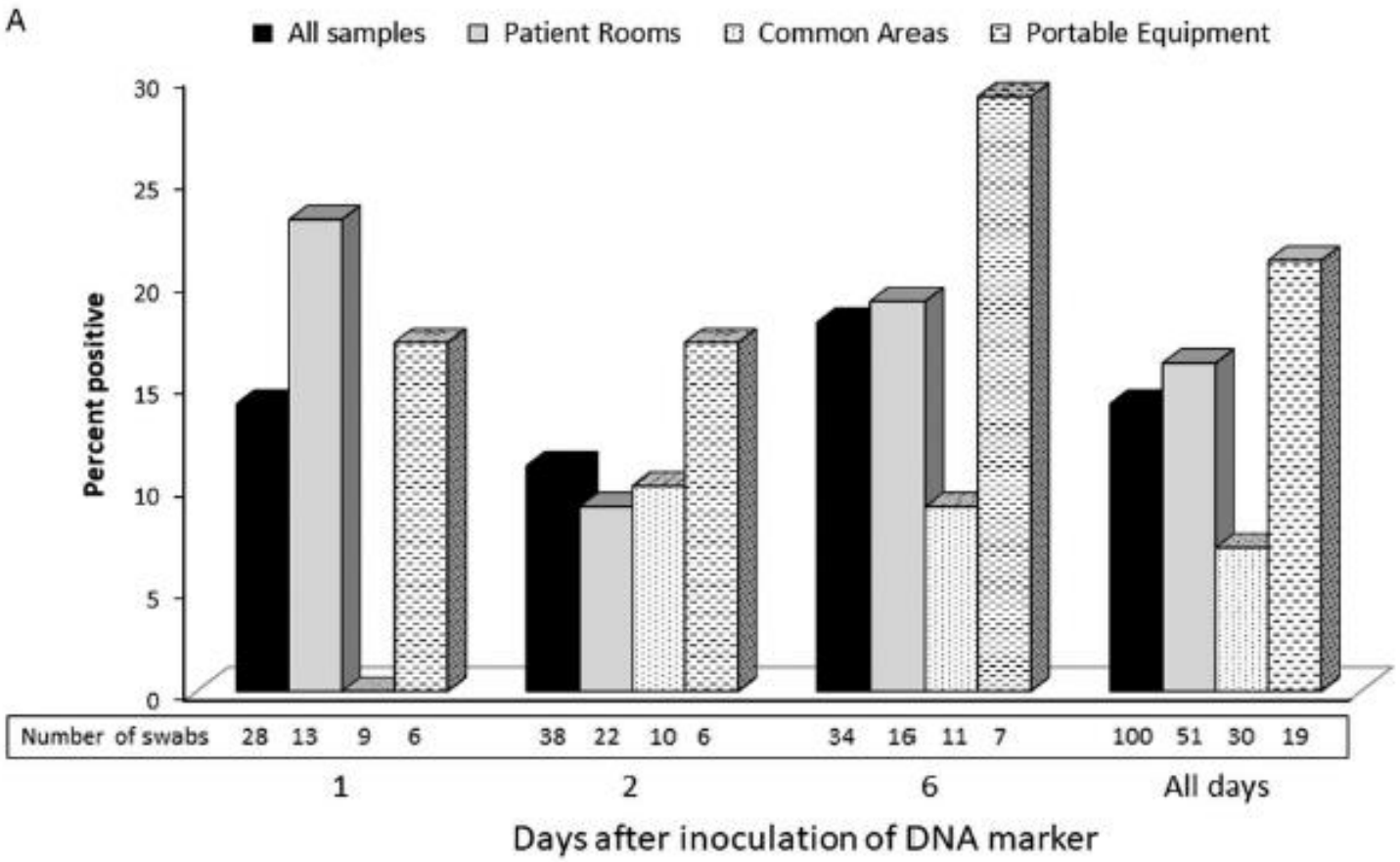
- **Twenty-four studies analyzed contamination of stethoscopes, with MRSA contamination prevalence of 0–42% and GNR prevalence of 0–31%.**
- **Twentyeight studies analyzed digital communication devices; 21 of these evaluated mobile phones explicitly. The range of MRSA contamination for phones was 0–20% and the range of GNR contamination for phones was 0–75%.**
- **One study of tablets had MRSA contamination of 50%.**
- **Eight studies on white coats yielded rates of MRSA contamination of 0–16%, with GNR contamination of white coats ranged from 0 to 42%.**
- **Neckties had a reported MRSA contamination rate of 3%–32% and GNR contamination of 11%–23% in 5 studies.**

Contaminated Portable Equipment Is a Potential Vector for Dissemination of Pathogens in the Intensive Care Unit

Amrita John, MBBS;[1,2] Heba Alhmidi, MD;[2] Jennifer L. Cadnum, BS;[2] Annette L. Jencson, BS, CIC;[2] Curtis J. Donskey, MD[3,4]

A DNA marker inoculated onto shared portable equipment in surgical and medical intensive care units disseminated widely to surfaces in patient rooms and provider work areas and to other types of portable equipment. These results demonstrate the potential for contaminated portable equipment to serve as a vector for dissemination of pathogens.

Infect Control Hosp Epidemiol 2017;38:1247–1249



Tracking and controlling soft surface contamination in health care settings

Jonathan D. Sexton PhD *, Amanda M. Wilson BS, Hannah P. Sassi PhD, Kelly A. Reynolds PhD

Mel & Enid Zuckerman College of Public Health, The University of Arizona, Tucson, AZ

Key Words:
Textiles
HAI
Pathogens
Sanitizer
Soft surface
Tracer

Background: Study objectives were to track the transfer of microbes on soft surfaces in health care environments and determine the efficiency of an Environmental Protection Agency (EPA)–registered soft surface sanitizer in the health care environment.

Methods: Soft surfaces at 3 health care facilities were sampled for heterotrophic plate count (HPC) bacteria, *Staphylococcus* spp, *Streptococcus pyogenes*, and *Escherichia coli* followed by a tracer study with a virus surrogate seeded onto volunteer hands and commonly touched surfaces. The occurrence of microbial contaminants was determined along with microbial reductions using the soft surface sanitizer. Soft surfaces were swabbed pre- and postintervention.

Results: Tracer viruses spread to 20%-64% and 13%-41% of surfaces in long-term health care facilities and physicians' offices, respectively. Only 1 pathogen, methicillin-resistant *Staphylococcus aureus*, was recovered. The waiting room chairs had the highest concentration of HPC bacteria before disinfection (145.4 ± 443.3 colony forming units [cfu]/cm^2), and the privacy curtains had the lowest (39.5 ± 84.2 cfu/cm^2). Reductions of up to 98.5% were achieved with the sanitizer in health care settings and up to 99.99% under controlled laboratory conditions.

Conclusions: Soft surfaces are involved in the spread of microbes throughout health care facilities. Routine application of an EPA-registered sanitizer for soft surfaces can help to reduce the microbial load and minimize exposure risks.

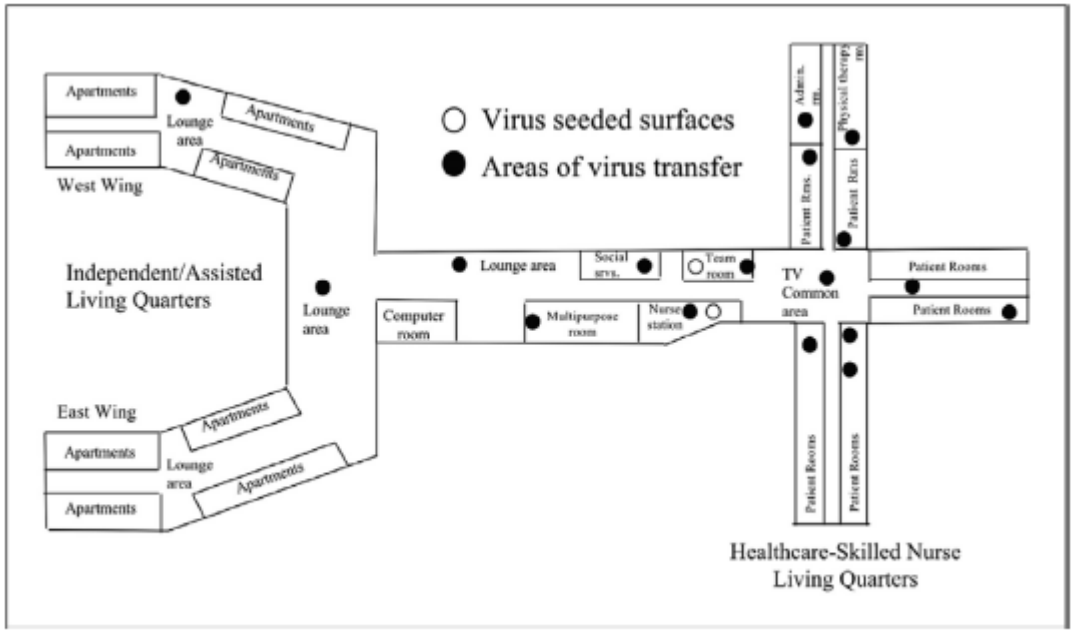


Fig 1. Long-term care facility C. *Admin.*, administration; *rm.*, room; *Rms.*, rooms; *srvs.*, services.

INFECTION CONTROL & HOSPITAL EPIDEMIOLOGY FEBRUARY 2017, VOL. 38, NO. 2

ORIGINAL ARTICLE

Challenging Residual Contamination of Instruments for Robotic Surgery in Japan

Yuhei Saito, MS; Hiroshi Yasuhara, MD, PhD; Satoshi Murakoshi, MD, PhD; Takami Komatsu, MD, PhD; Kazuhiko Fukatsu, MD, PhD; Yushi Uetera, MD, PhD

TABLE 1. Amount of Protein Released From Instruments in Study of Residual Contamination of Instruments for Robotic Surgery in Japan

	After use for operation		After in-house cleaning			
Instrument type	Measurement No. 1 (μg)	N	Measurement No. 2 (μg)	Measurement No. 3 (μg)	Measurement No. 4 (μg)	N
Instruments for robotic surgery						
Large needle driver	$83.7 \pm 15.8 \times 10^3$	16	566 ± 108	421 ± 58	410 ± 68	6
Forceps with large jaws	$71.6 \pm 18.0 \times 10^3$	8	627 ± 114	497 ± 48	501 ± 71	6
Maryland bipolar forceps	$63.2 \pm 21.0 \times 10^3$	8	841 ± 120	709 ± 107	671 ± 144	6
Monopolar curved scissors	$60.5 \pm 21.3 \times 10^3$	9	547 ± 58	576 ± 98	553 ± 77	6
Instruments for open surgery						
Pean forceps	$5.3 \pm 3.0 \times 10^3$	6	23.2 ± 2.7	18.1 ± 5.4	19.1 ± 1.8	8
DeBakey tweezers	$9.6 \pm 2.3 \times 10^3$	6	17.1 ± 5.1	20.8 ± 5.0	17.9 ± 3.0	8
Mathieu needle holders	$2.0 \pm 1.1 \times 10^3$	6	15.6 ± 5.4	18.8 ± 6.0	24.5 ± 7.4	8
Hand-held retractors	$1.6 \pm 1.0 \times 10^3$	6	16.7 ± 5.4	12.6 ± 3.8	15.8 ± 3.9	8
Metzenbaum scissors	$12.4 \pm 8.0 \times 10^3$	3	9.7 ± 1.9	14.8 ± 3.7	8.4 ± 3.1	8

NOTE. Data are presented as mean ± SEM.

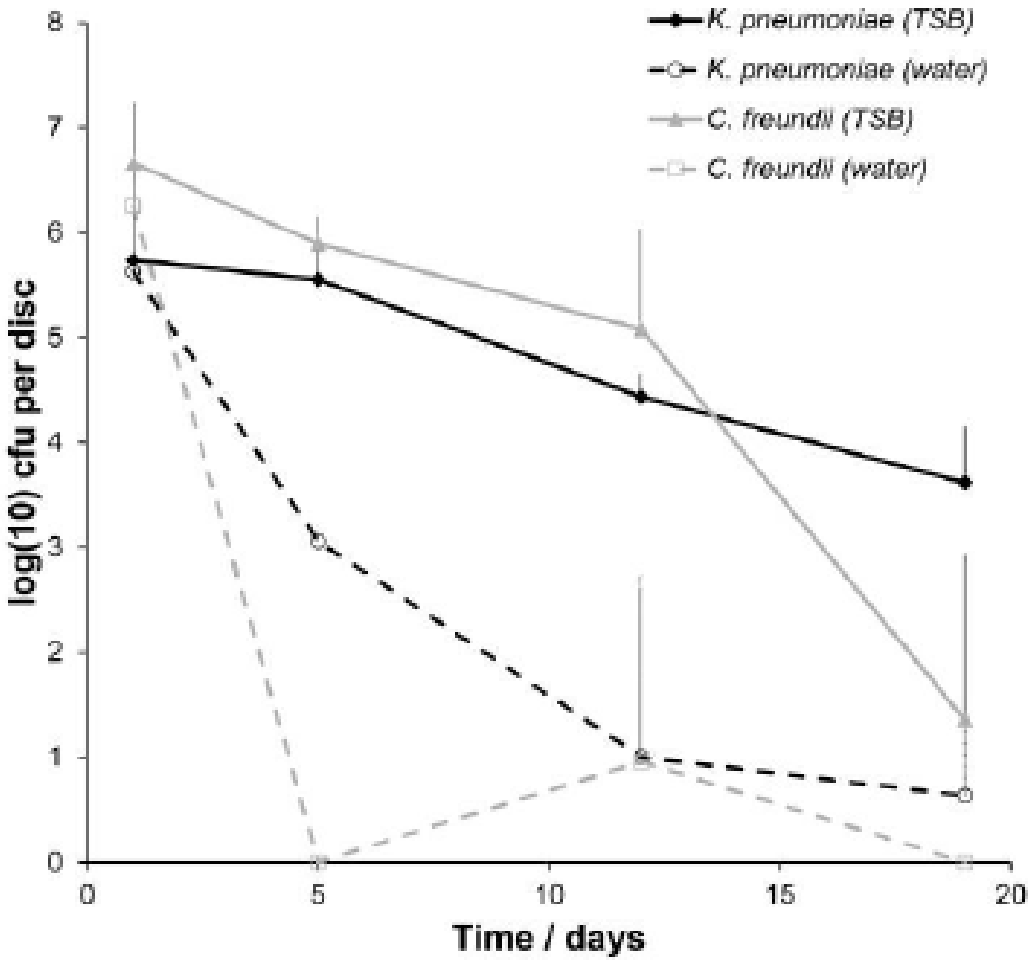
- **Conclusions. …….complete removal of residual protein from surgical instruments is virtually impossible. The pattern of decline differed depending on the instrument type, which reflected the complex structure of the instruments. It might be necessary to establish a new standard for cleaning using a novel classification according to the structural complexity of instruments especially for those for robotic surgery.**

Properties of hospital pathogens

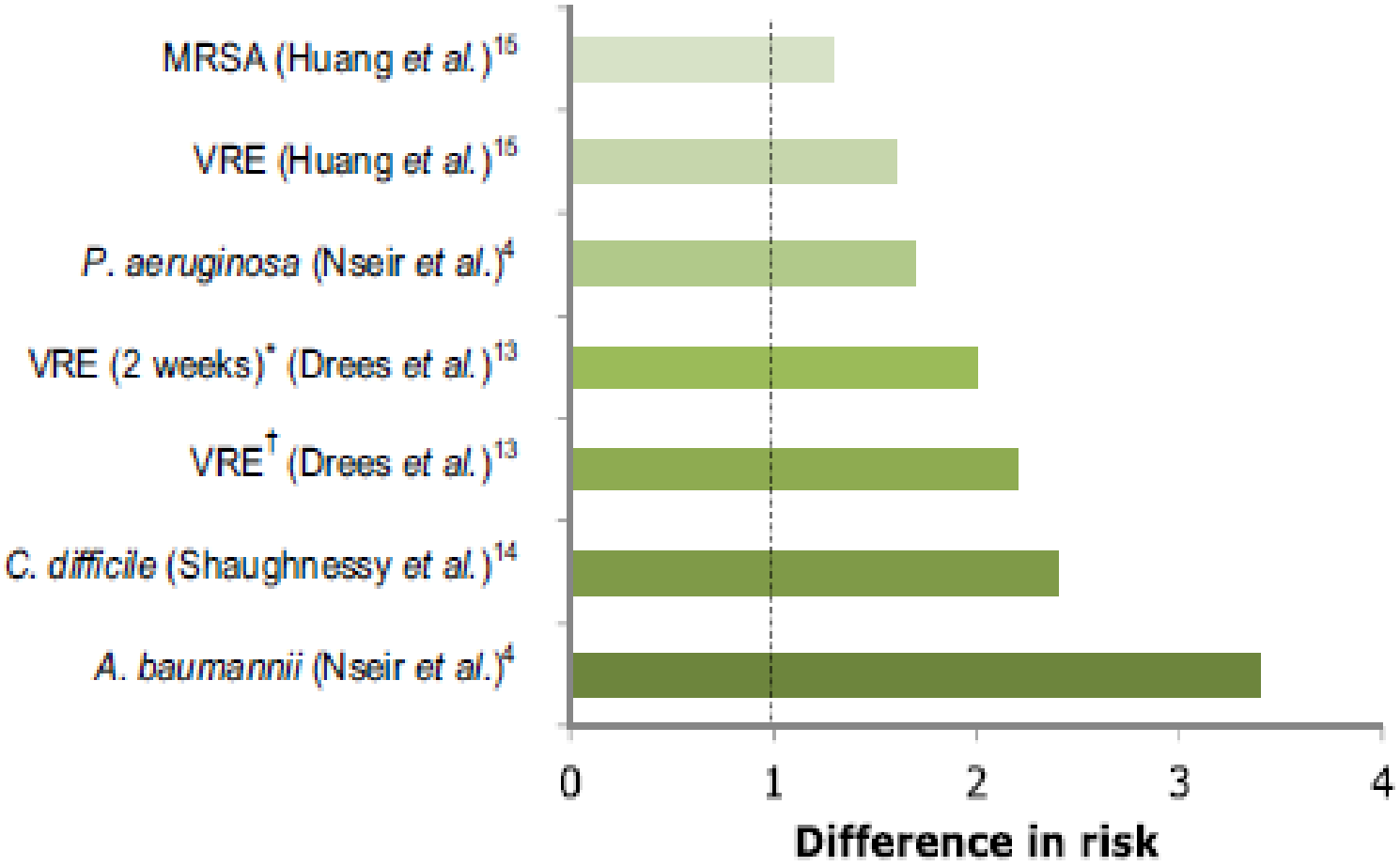
	Survival time	*Infectious dose*
MRSA	7 days to >7 months	4 cfu's
Acinetobacter	3 days to >5 months	250 cfu's
C.difficile	>5 months	7 spores
VRE	5 days to >4 months	$<10^3$ cfu's
Norovirus	8 hours to 7 days	10-100 virions

Kramer, BMC Infect Dis, 2006; Wagenvoort, JHI 2000; Chiang, Crit Care Med 2009; Wilcox M, 2010; Larson, Lancet 1978; Kjerulf et al, APMIS 1998

Extended Survival of Carbapenem-Resistant Enterobacteriaceae on Dry Surfaces
Author(s): Nancy L. Havill, MT(ASCP), CIC; John M. Boyce, MD; Jonathan A. Otter, PhD
Source: *Infection Control and Hospital Epidemiology*, Vol. 35, No. 4, Special Topic Issue: Carbapenem-Resistant Enterobacteriaceae and Multidrug-Resistant Organisms (April 2014), pp. 445-447



Aumento del rischio associato con la condivisione di una stanza dove precedentemente è stato ricoverato un paziente:



J.A. Otter et al. / American Journal of Infection Control 41 (2013) S6-S11

OPEN ACCESS Freely available online March 2013 | Volume 8 | Issue 3 | e59015 PLOS ONE

A Long-Term Low-Frequency Hospital Outbreak of KPC-Producing *Klebsiella pneumoniae* Involving Intergenus Plasmid Diffusion and a Persisting Environmental Reservoir

Ståle Tofteland[1]*, Umaer Naseer[2,3], Jan Helge Lislevand[1], Arnfinn Sundsfjord[2,3], Ørjan Samuelsen[2]*

- A 12-bed intensive care unit.
- KPC-producing ***K. pneumoniae*** were identified from the **sink drains** in room 5 (K67-11 and K67-15) and room 6 (K67-13 and K67-14), and bla KPC-positive ***E. asburiae*** from the **sink drain** in room 5 (K67-12 and K67-16). The same ST258-KPC2 strain was identified in 6 out of 7 patients.

- After sinks and sink traps **decontamination, bla-positive K. pneumoniae was again recovered**, suggesting that these strains can survive well in that environment.

- **Contamination of the hands of health care workers** due to occasional **backsplash** during hand washing in a contaminated sink and sink drains or through moist surfaces near sinks and faucets **has been suggested as a possible mode of transmission** to health care workers and subsequently to patients in the ICU setting, facilitating low-frequent transmissions.

Available online at www.sciencedirect.com

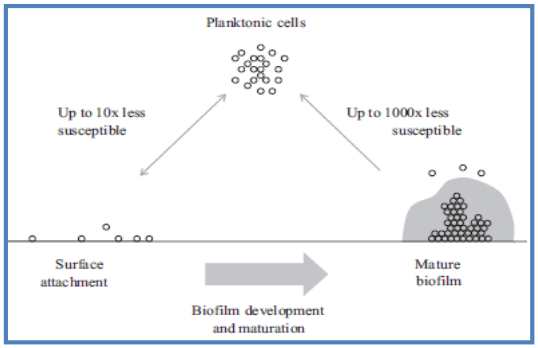
Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Review

Surface-attached cells, biofilms and biocide susceptibility: implications for hospital cleaning and disinfection

J.A. Otter [a,b,*], K. Vickery [c], J.T. Walker [d], E. deLancey Pulcini [e], P. Stoodley [f,g], S.D. Goldenberg [a], J.A.G. Salkeld [b], J. Chewins [b], S. Yezli [b], J.D. Edgeworth [a]



- **Microbes tend to attach to available surfaces and readily form biofilms, which is problematic in healthcare settings.**
- **Biofilms are traditionally associated with wet or damp surfaces such as indwelling medical devices and tubing on medical equipment.**
- **However, microbes can survive for extended periods in a desiccated state on dry hospital surfaces.**
- **Microbes attached to surfaces and in biofilms are less susceptible to biocides, antibiotics and physical stress.**
- **Thus, surface attachment and/or biofilm formation may explain how vegetative bacteria can survive on surfaces for weeks to months, interfere with attempts to recover microbes through environmental sampling, and provide a mixed bacterial population for the horizontal transfer of resistance genes.**

Journal of Hospital Infection 89 (2015) 16–27

Journal of Hospital Infection 91 (2015) 35–44

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Intensive care unit environmental surfaces are contaminated by multidrug-resistant bacteria in biofilms: combined results of conventional culture, pyrosequencing, scanning electron microscopy, and confocal laser microscopy

H. Hu[a], K. Johani[a,b], I.B. Gosbell[c,d], A.S.W. Jacombs[a], A. Almatroudi[a,e], G.S. Whiteley[f], A.K. Deva[a], S. Jensen[c], K. Vickery[a,*]

Prevalence of biofilm on intensive care unit dry surfaces

Item	*N*	Biofilm	Live at 12 months (*N* = 18)	PCR positive: *S. aureus*	Culture positive:			
					Non-selective media	MRSA	VRE	ESBL
Patient bedding								
Mattress	6	6	5	4	5	2	2	1
Pillow	5	5	3	4	3	1	0	1
Patient surrounds								
Curtain	9	8	4	5	5	3	0	1
Patient notes wire clip	2	2		0	0	—	—	—
Supply box	4	4	2	1	3	0	0	0
Glove box Velcro	1	1	1	1	1	0	1	1
Notice	3	3		1	2	1	0	0
Fixed furnishings								
Floor	3	3		1	3	1	0	0
Basin rubber	4	3		1	0	—	—	—
Bench top	2	1	1	2	0	—	—	—
Wall	1	1		0	1	0	0	1
Ward entry door	4	4	2	2	0	—	—	—
Total	44	41	18/18	22	23	8	3	5

N, the number of items collected; 'Biofilm', the number of samples with visual confirmation of biofilm presence by microscopy; 'Live at 12 months', the confirmation of live bacteria following 12 months of storage; PCR, polymerase chain reaction; MRSA, meticillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant enterococci; ESBL, extended-spectrum beta-lactamase Gram-negative bacilli.

Journal of Hospital Infection 91 (2015) 218–219

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Commentary

Biofilms mean that the 'environmentome' of hospital surfaces is teeming with life

For many years we have described hospital surfaces as 'inanimate' but the study by Hu *et al*. demonstrates that this is far from true.[1] A sentinel study published in this Journal in 2012 first identified biofilms on a small number of surfaces in an Australian intensive care unit (ICU).[2] The study by Hu *et al*. published in the September edition of the Journal from the same Australian group identifies established biofilms on the vast majority of surfaces sampled in a similar setting to the 2012 study, supporting a diverse array of microbes including pathogenic species.

The diversity of bacteria identified in the biofilms was broad: **obligate anaerobes accounted for around 50% of the bacterial species identified**. This suggests that these obligate anaerobes **resided in the anaerobic portions of the biofilms**.

The identification of **biofilms on dry hospital surfaces** might explain why vegetative bacteria remain **viable on dry hospital surfaces for such long periods**, explain why conventional **cleaning and disinfection consistently fails to eliminate pathogens from surfaces.**

Journal of Hospital Infection 93 (2016) 263–270

Available online at www.sciencedirect.com

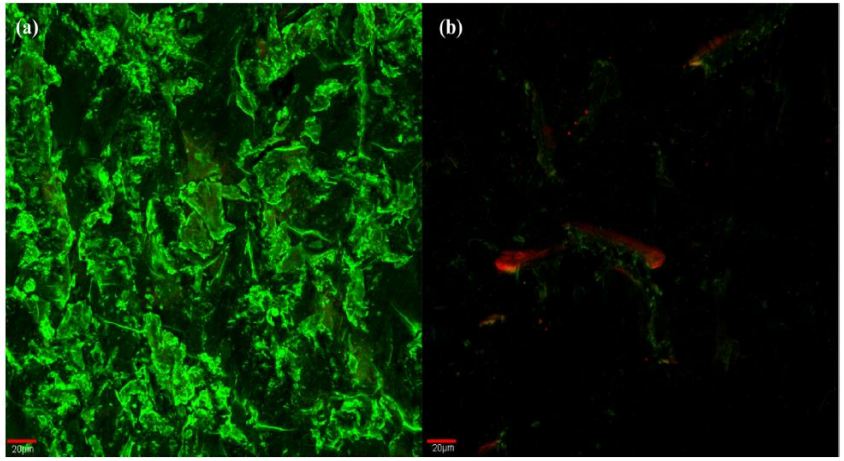
Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

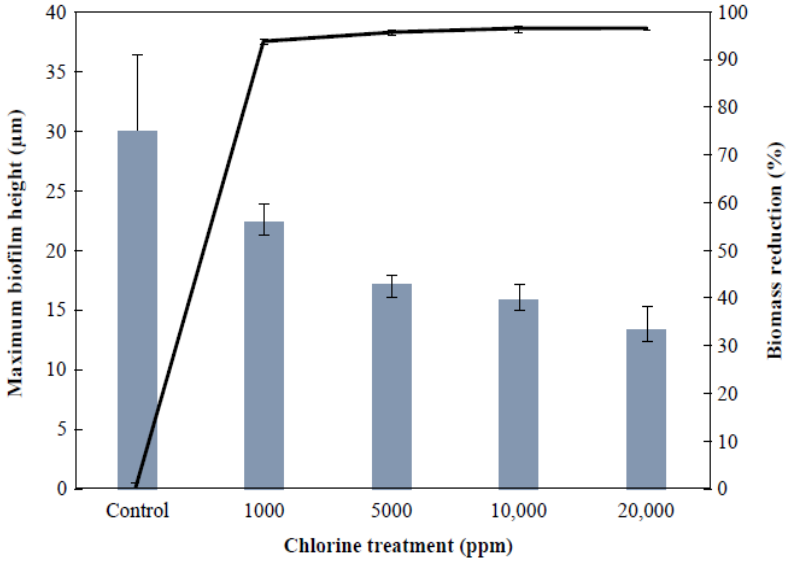
Staphylococcus aureus dry-surface biofilms are not killed by sodium hypochlorite: implications for infection control

A. Almatroudi [a,b], I.B. Gosbell [c,d,e], H. Hu [a], S.O. Jensen [c,d], B.A. Espedido [c,d], S. Tahir [a], T.O. Glasbey [f], P. Legge [a], G. Whiteley [f], A. Deva [a], K. Vickery [a,*]

Hypochlorite exposure reduced plate counts by a factor of 7 log10, and **reduced biofilm biomass by a factor of 100**; however, staining of residual biofilm showed that live ***S. aureus*** **cells remained**.



hypochlorite-treated (**20,000 ppm**) biofilm showing significantly reduced numbers of live (green) and dead (red) bacteria



Topic: Environment

ID: 4420

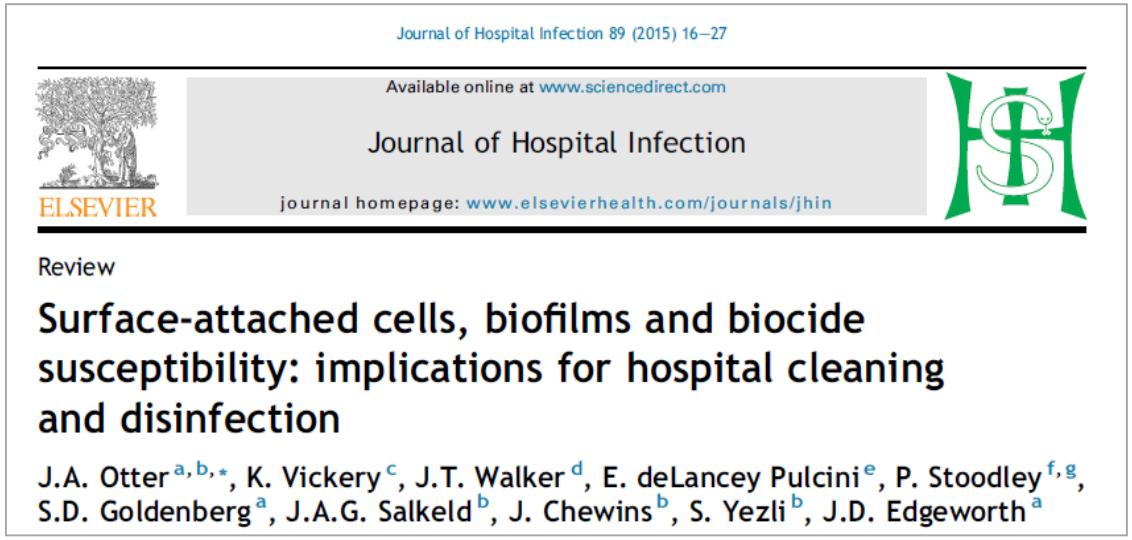
Transfer frequency of dry surface biofilm in health-care environment – the role of health care worker's hand

Durdana Chowdhury, Shamaila Tahir, Mark Legge, Honghua Hu, Khalid Aljohani, Anand Deva, Karen Vickery. *Macquarie University*

Le mani degli operatori possono contaminarsi dal contatto con il biofilm secco.

Results: Transmission of organisms was 10 times higher with bare hands than gloved hands. Both nitrile gloves and surgical gloves transmitted approximately 6 times the bacteria than latex gloves. Following hand contamination with DSB, transmission to 20 subsequent surfaces was highly possible. Cotton bed sheet also showed higher rate of transmissibility. It is astonishing that, 7.3% organism can pass through cotton sheet to contaminate skin of hands. Surprisingly, DSB treated with 5% neutral detergent increased the transmission rate of DSB bacteria tenfold.

Discussion and/or Conclusion(s): DSB is highly transmissible. It is higher with bare hand and can be transmitted to the patient from bed mattress, through the bed sheet.



Journal of Hospital Infection 89 (2015) 16–27

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Review

Surface-attached cells, biofilms and biocide susceptibility: implications for hospital cleaning and disinfection

J.A. Otter[a,b,*], K. Vickery[c], J.T. Walker[d], E. deLancey Pulcini[e], P. Stoodley[f,g], S.D. Goldenberg[a], J.A.G. Salkeld[b], J. Chewins[b], S. Yezli[b], J.D. Edgeworth[a]

Nuovi approcci per la pulizia e disinfezione ambientale

The capacity of existing detergent formulations and disinfectants to disrupt biofilms may have an important and previously unrecognized role in determining their effectiveness in the field, which should be reflected in **testing standards.**

This will inform new approaches to hospital cleaning and disinfection, including **novel surfaces that reduce microbial attachment and improve microbial detachment,** and methods to augment the activity of biocides against surface-attached microbes such as **bacteriophages and antimicrobial peptides.**

Journal of Hospital Infection 95 (2017) 3–45

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Review

Control of carbapenemase-producing Enterobacteriaceae outbreaks in acute settings: an evidence review

C.E. French[a,b], C. Coope[b,c,*], L. Conway[b,c], J.P.T. Higgins[a,b], J. McCulloch[c], G. Okoli[a], B.C. Patel[c], I. Oliver[b,c]

[a] University of Bristol, Bristol, UK
[b] NIHR Health Protection Research Unit in Evaluation of Interventions at University of Bristol, Bristol, UK
[c] Public Health England, Bristol, UK

Conclusions

CPE is an ongoing and challenging global public health problem. Outbreaks provide an opportunity to evaluate control measures to inform future guidelines. Better reporting of CPE outbreaks……would be helpful. Though many reported CPE outbreaks appear to be successfully controlled, optimising the timeliness of control measures and better understanding of which control measures are most effective will enable resources to be most wisely allocated and reduce transmission. Environmental transmission may play an important part in hospital outbreaks and it should be considered

Journal of Hospital Infection 92 (2016) S1–S44

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Guidelines

Prevention and control of multi-drug-resistant Gram-negative bacteria: recommendations from a Joint Working Party

A.P.R. Wilson [a,*], D.M. Livermore [b], J.A. Otter [c], R.E. Warren [d], P. Jenks [e], D.A. Enoch [f], W. Newsholme [g], B. Oppenheim [h], A. Leanord [i], C. McNulty [j], G. Tanner [k], S. Bennett [l], M. Cann [m], J. Bostock [n], E. Collins [o], S. Peckitt [p], L. Ritchie [q], C. Fry [r], P. Hawkey [s]

6. Summary of guidelines

6.4. Cleaning and environment

19. Environmental screening should be considered where there is unexplained transmission of MDR Gram-negative organisms or a possible common source for an outbreak. Strong

20. Respiratory and other contaminated equipment should be decontaminated (or respiratory secretions discarded) away from the immediate bed area in designated cleaning sinks and not in handwash sinks. Strong

21. For P. aeruginosa, including MDR strains, at a minimum, in accordance with the organization's water safety plan, a risk assessment should be made when levels of patient colonization or infection rise in order to determine if point-of-use filters should be installed or if taps need to be changed. Strong

22. Terminal disinfection of vacated areas with hypochlorite should be used in the control of outbreaks of infection due to MDR Gram-negative bacteria. Conditional

23. Hydrogen peroxide vapour should be considered as an adjunctive measure following cleaning of vacated isolation rooms/areas. Conditional

24. The routine use of selective decontamination of the mouth or digestive tract is not recommended for control of MDR Gram-negative bacteria. Conditional

Obbiettivi della Sanificazione

- **Pulizia**
- **Comfort**
- **Manutenzione e integrità delle superfici**
- **Eliminare i serbatoi dei microrganismi**
  - **Limitare la trasmissione dei microrganismi a partire dalle superfici ambientali inerti**

Qualità Attese dalle Operazioni di Sanificazione

- **Operazione non contaminante**
  - **per l'ambiente**
  - **per l'operatore**
- **Operazione efficace**
  - **pulizia macroscopica**
  - **pulizia "biologica"**
  - **pulizia microbiologica**
- **Fattibile**
  - **Personale, mezzi, tempo, costi….**

Journal of Hospital Infection

Volume 45, Issue 1, May 2000, Pages 19–28

Regular Article

An evaluation of hospital cleaning regimes and standards

C.J. Griffith[a], R.A. Cooper[a], J. Gilmore[b], C. Davies[a], M. Lewis[b]

113 superfici ambientali sono risultate “pulite” nel:

82-91% ispezione visiva
10-14% determinazione ATP
30-45% analisi microbica

What is clean?.....what an individual thinks it is!

We should not define cleanliness without indicating how we would assess it

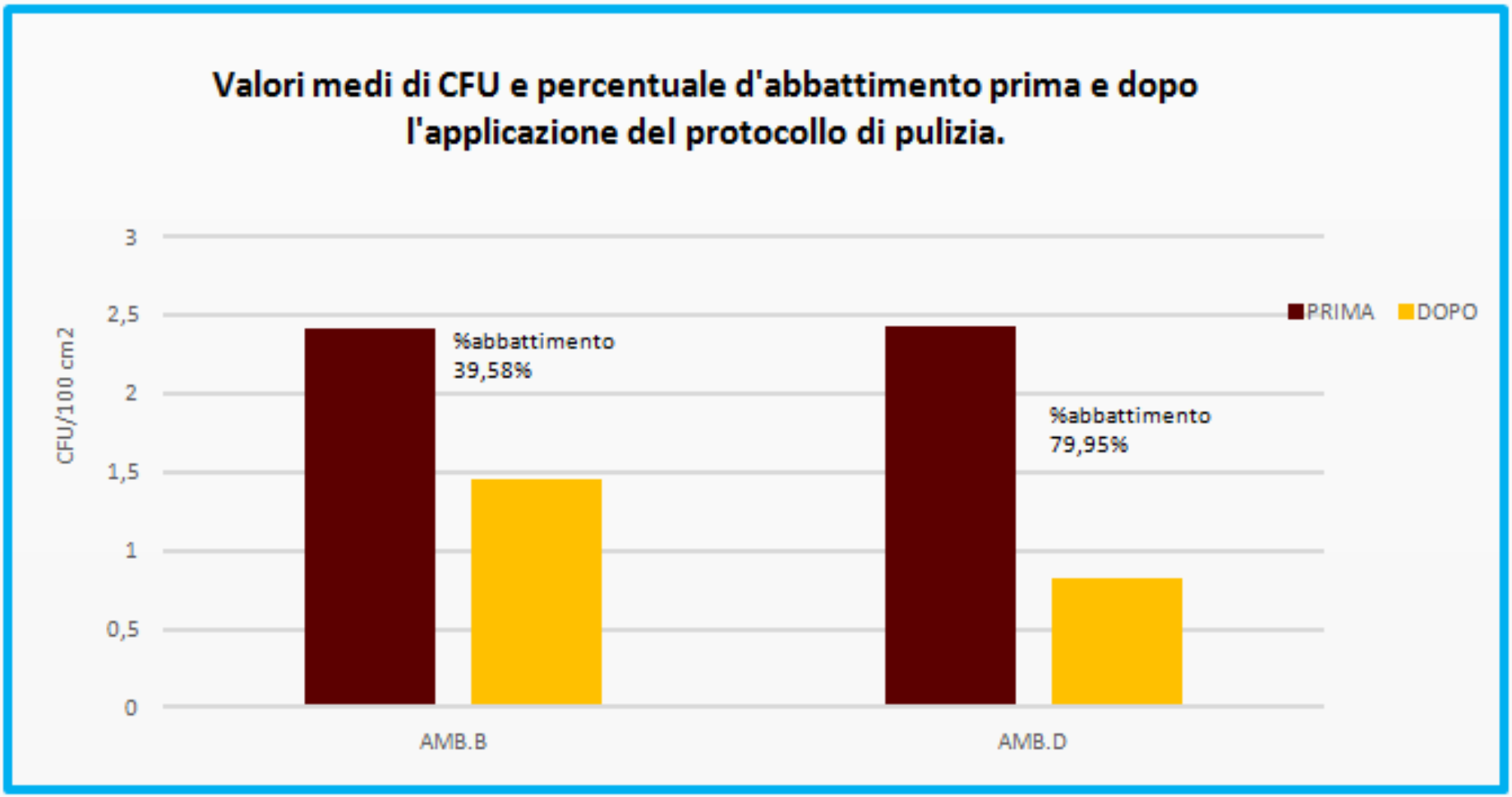
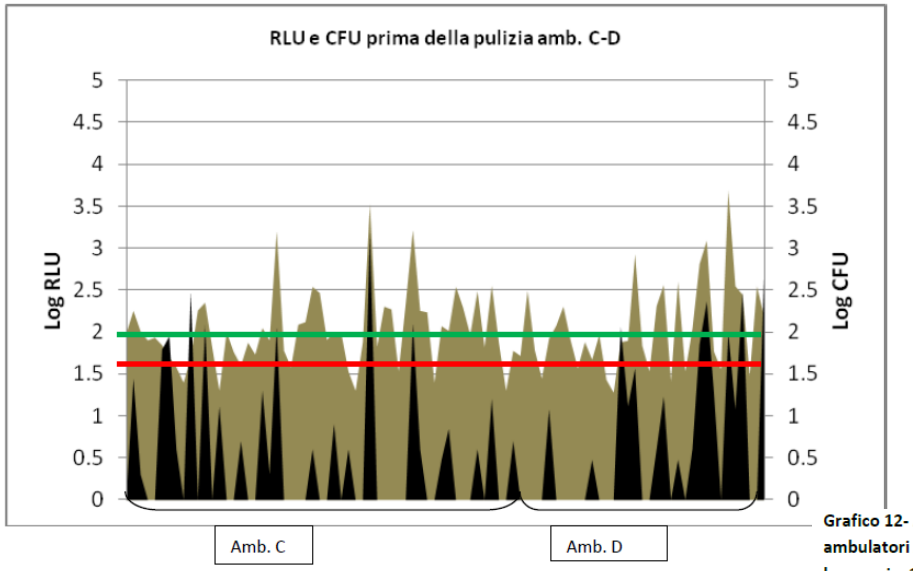
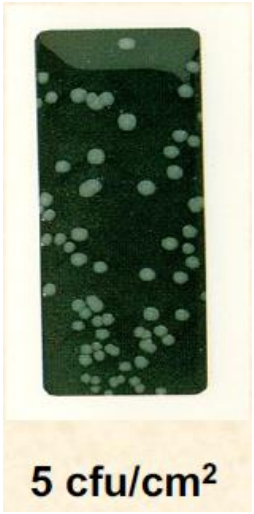

Valori medi di CFU e percentuale d'abbattimento prima e dopo l'applicazione del protocollo di pulizia.
CFU/100 cm2
3
2,5
2
1,5
1
0,5
0
PRIMA
DOPO
%abbattimento
39,58%
%abbattimento
79,95%
AMB.B
AMB.D

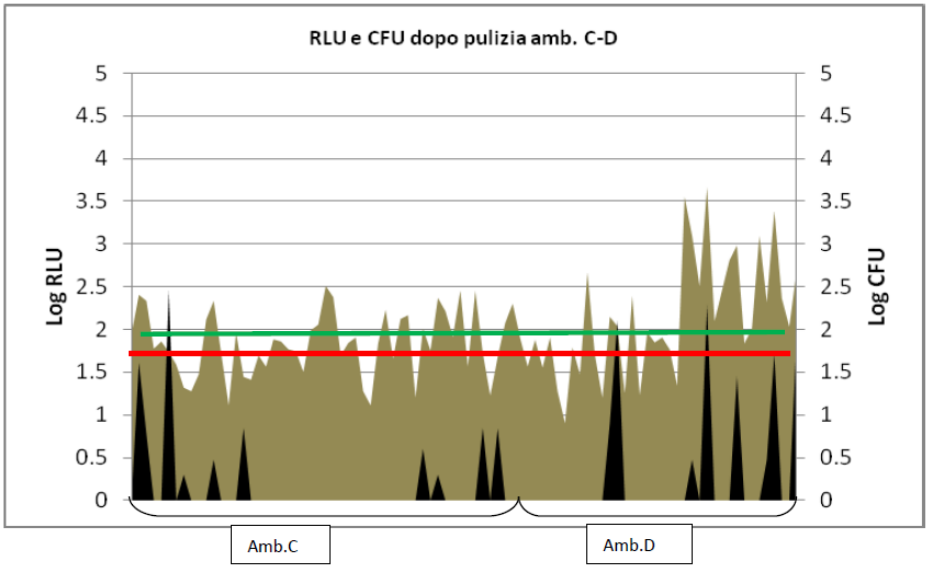
Grafico 10- Andamento dei valori di RLU e CFU (rispettivamente rappresentati nel grafico dall'area beige e dall'are nera), negli ambulatori C-D, durante il periodo della sperimentazione prima della pulizia (la linea rossa indica il benchmark degli RLU, espresso in log , pari a 1,6 ; la linea verde il benchmarch per i CFU pari a 2)

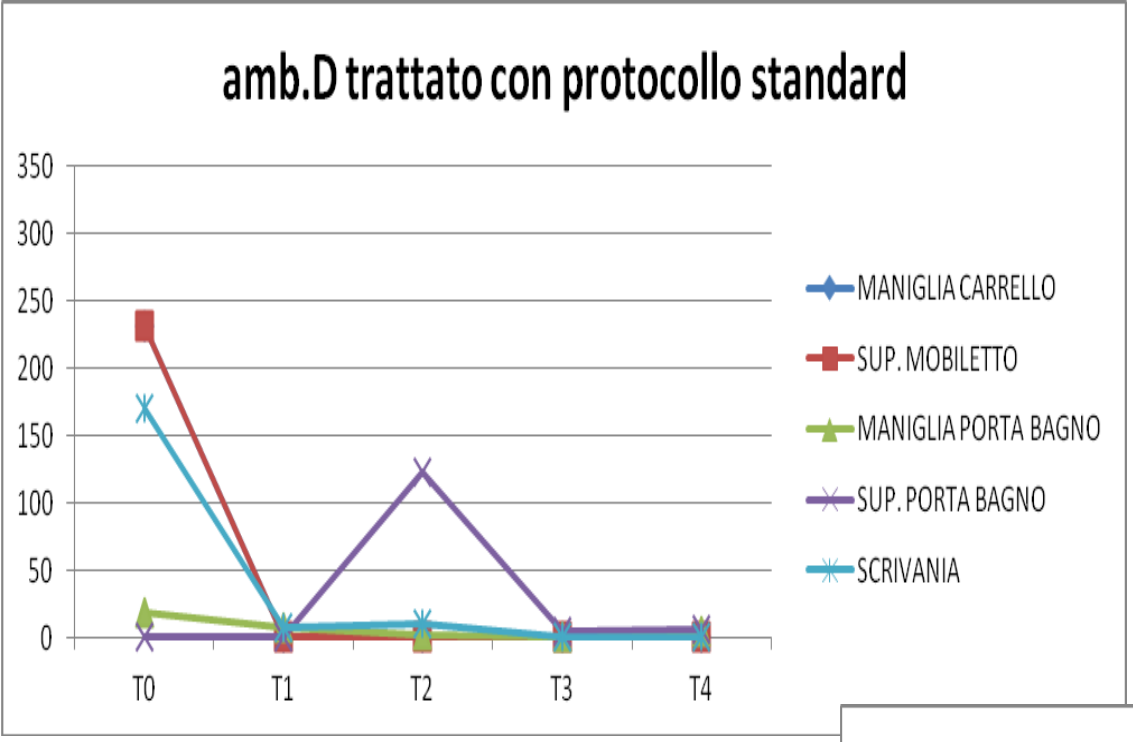


Come misurare il "pulito"?

Grafico 12- Andamento dei valori di RLU e CFU (rispettivamente rappresentati nel grafico dall'area beige e dall'are nera) , negli ambulatori A-B, durante il periodo della sperimentazione dopo la pulizia (la linea rossa indica il benchmark degli RLU, espresso in log , pari a 1.6 ; la linea verde il benchmarch per i CFU pari a 2,5)



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T2
T3
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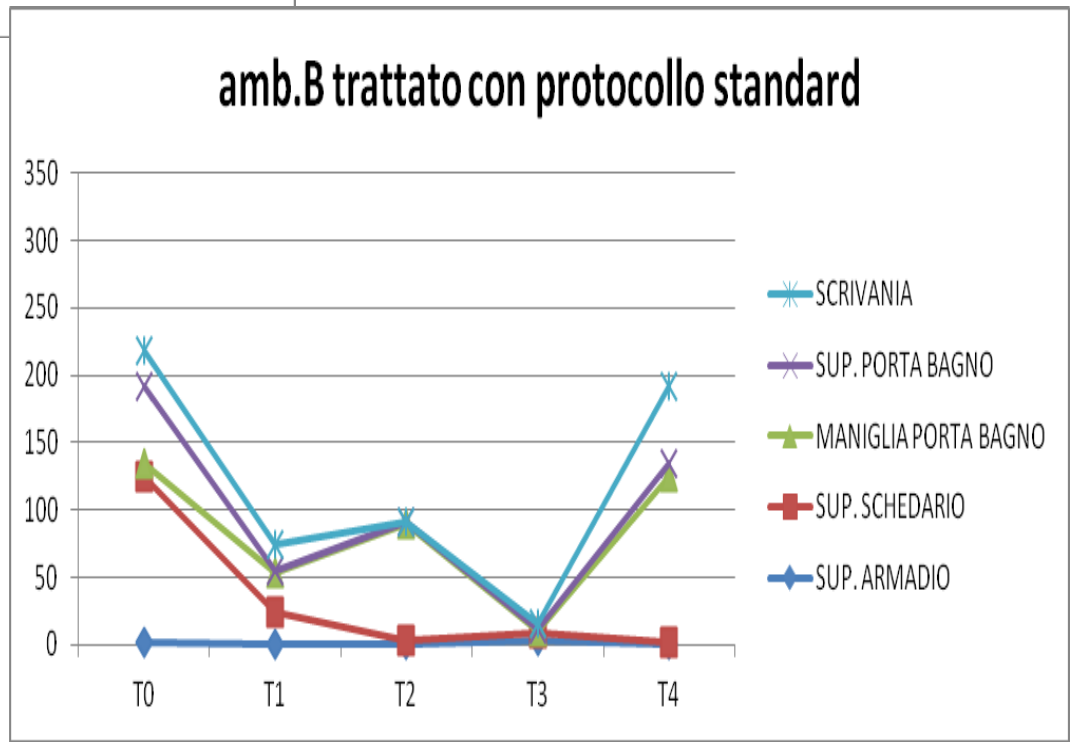
SUP. MOBILETTO
MANIGLIA PORTA BAGNO
SUP. PORTA BAGNO
SCRIVANIA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SCRIVANIA
SUP. PORTA BAGNO
MANIGLIA PORTA BAGNO
SUP. SCHEDARIO
SUP. ARMADIO

What is the evidence for cleaning as a viable control mechanism for hospital-acquired infections ?

BBC website, 2008

Two matched wards received one extra cleaner (Monday to Friday), with each ward receiving enhanced cleaning for six months in a cross-over design;

Enhanced cleaning led to a 33% reduction in levels of microbial soil at hand-touch sites; and 27% reduction in new MRSA infections, despite higher bed occupancies and MRSA colonisation pressures (p=0.032: 95% CI 7.7%, 92.3%).

Dancer et al, BMC Med, 2009

American Journal of Infection Control 44 (2016) e69-e76

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Monitoring and improving the effectiveness of surface cleaning and disinfection

William A. Rutala PhD, MPH [a,b,*], David J. Weber MD, MPH [a,b]

[a] Hospital Epidemiology, University of North Carolina Health Care, Chapel Hill, NC
[b] Division of Infectious Diseases, UNC School of Medicine, Chapel Hill, NC

IMPROVING ROOM CLEANING AND DISINFECTION AND DEMONSTRATING THE EFFECTIVENESS OF SURFACE DECONTAMINATION IN REDUCING HAIS

We have found that collaboration between infection prevention and environmental services staff and management is critical to an effective environmental cleaning program. This includes ensuring that environmental services staff recognize the importance of their job and the relationship of adhering to proper work procedures to the reduction of microbial contamination and HAIs. The assignment of cleaning responsibility (eg, medical equipment to be cleaned by nursing; environmental surfaces to be cleaned by environmental services) is also important to ensure all objects and surfaces in a patient room are decontaminated, especially the surfaces of medical equipment (eg, cardiac monitors).

Was the extra cleaning cost effective?

- The study cleaner earned £12,320 per annum
- Consumables were £1,100
- Average cost of one hospital-acquired MRSA surgical site infection at least £9,000
- Enhanced cleaning spared 5-9 patients MRSA
- The hospital thus saved £45,000-£81,000 minus the costs of cleaners and consumables
- Overall savings estimated as £31,600 - £67,600 for two wards over a 1 year period

Dancer et al, BMC Med 2009

Nuove Aree di Attenzione

- **L’impatto ambientale**
- **La sicurezza del personale**
- **La natura delle superfici da decontaminare**
- **Le metodiche innovative**
- **La ridotta suscettibilità ai disinfettanti**