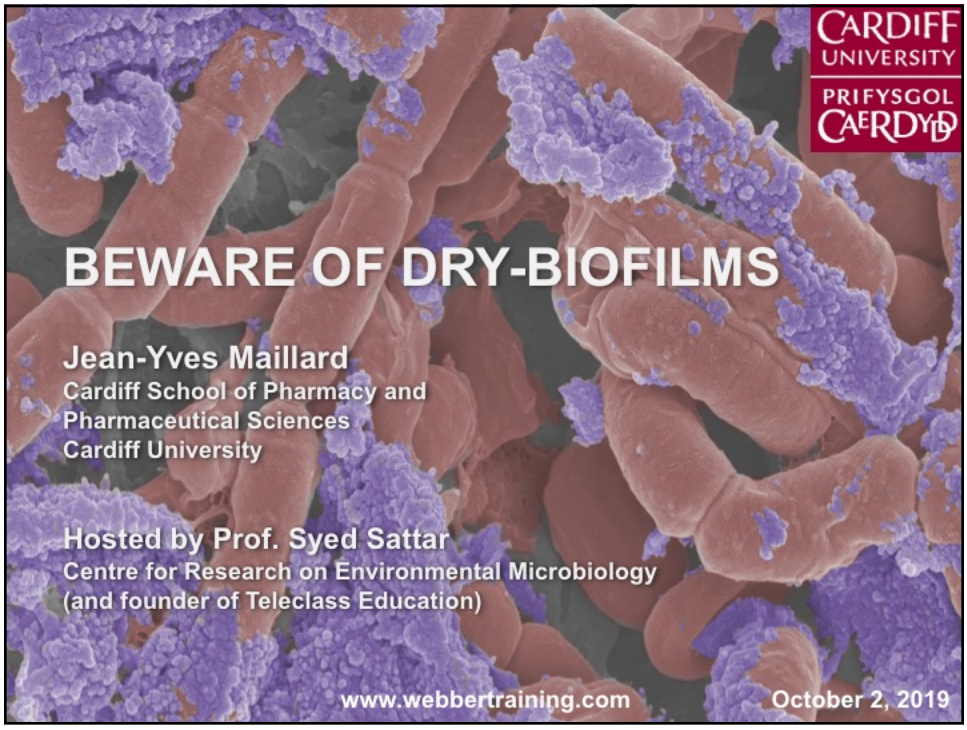
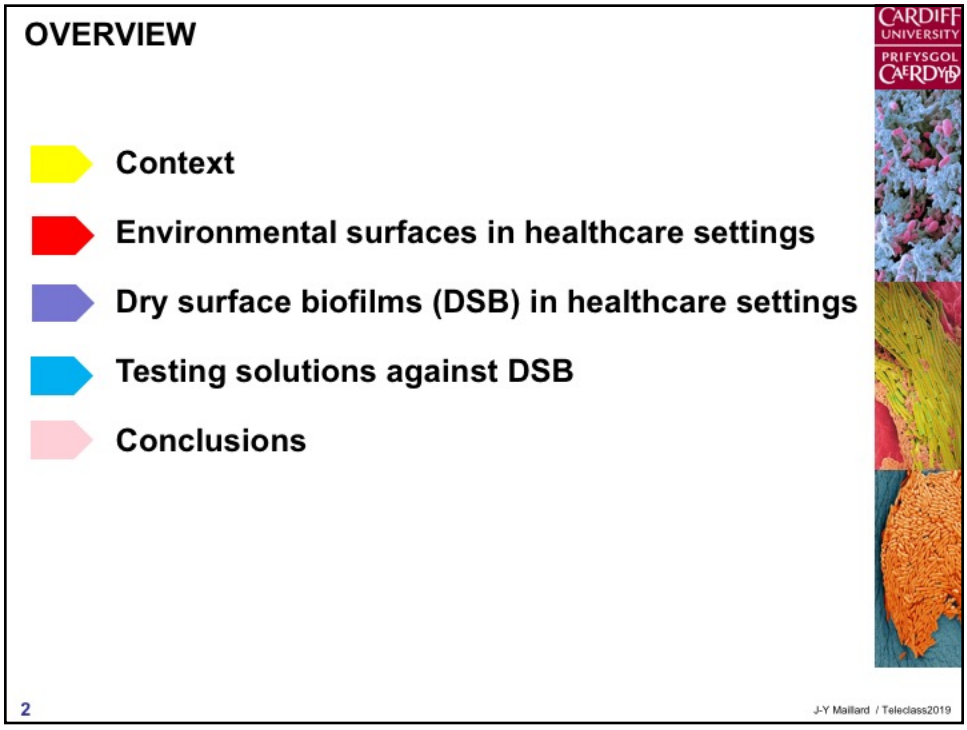
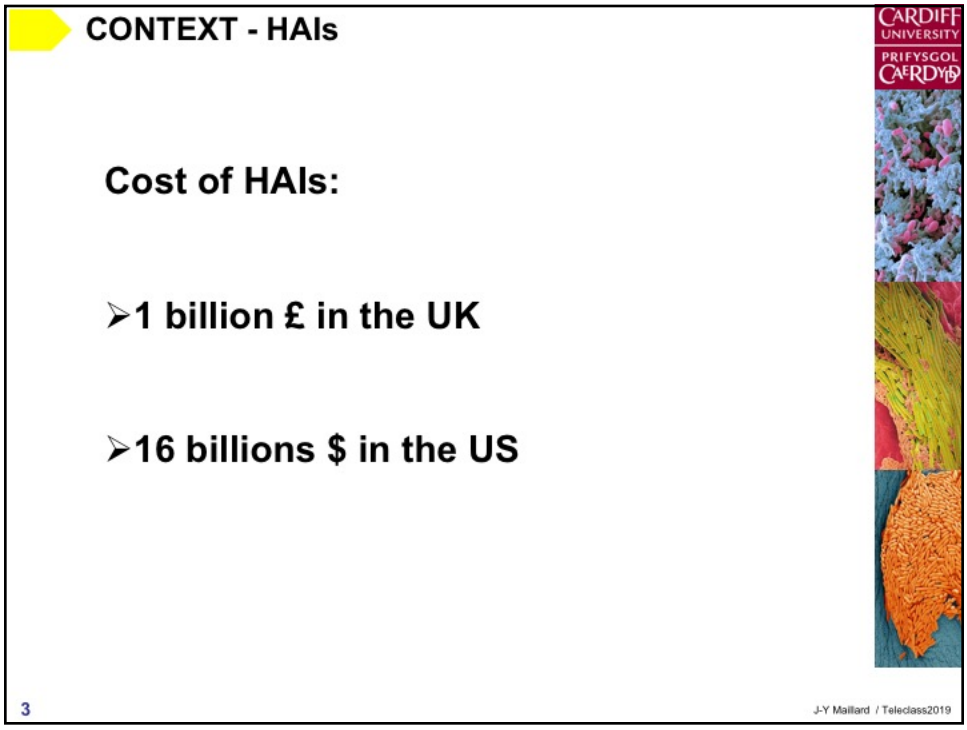
Are Towelettes Effective for Surface Decontamination in Healthcare Settings?
Prof. Jean-Yves Maillard, Cardiff University, Wales
A Webber Training Teleclass





Hosted by Prof. Syed A. Sattar, CREM
www.webbertraining.com


CONTEXT - HAIs
Cost of HAIs:
➢1 billion £ in the UK
➢16 billions $ in the US
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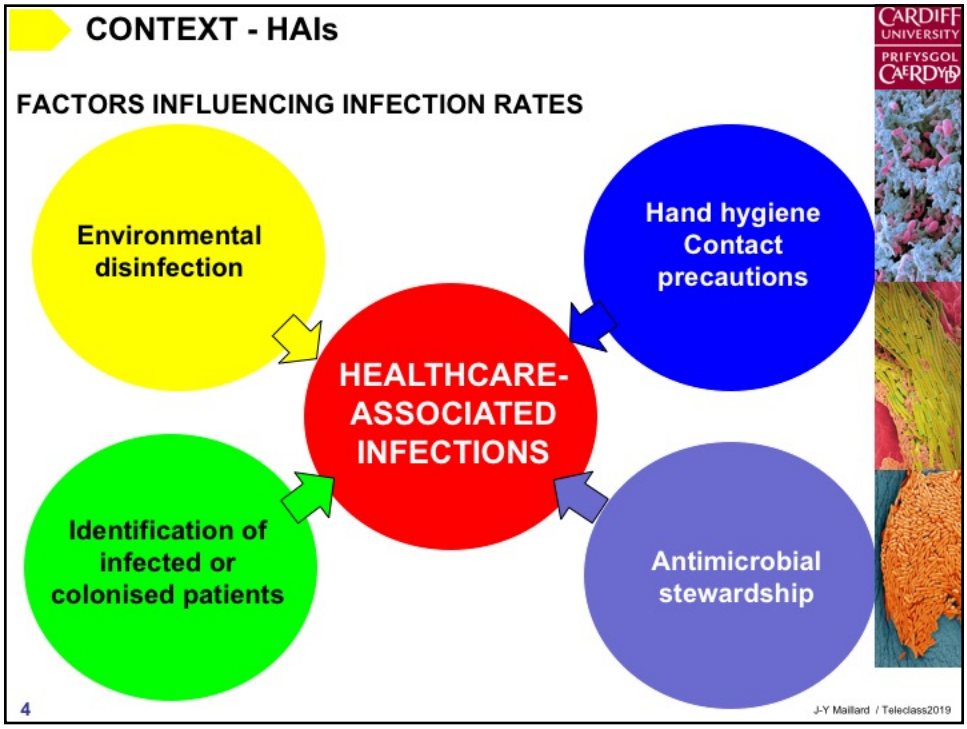
CONTEXT - HAIs
FACTORS INFLUENCING INFECTION RATES
Environmental disinfection
Hand hygiene Contact precautions
HEALTHCARE-ASSOCIATED INFECTIONS
Identification of infected or colonised patients
Antimicrobial stewardship
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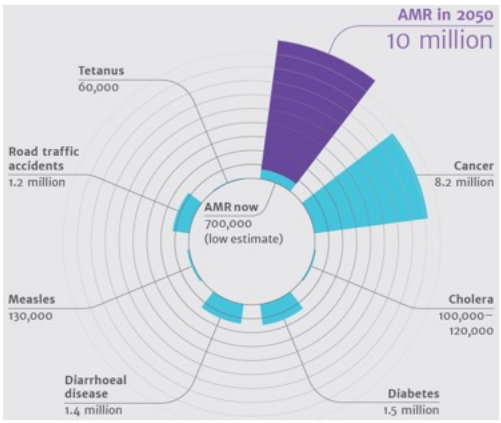
CONTEXT – RISE OF AMR



O'Neill. 2016. Tackling drug-resistant infections globally: Final report and recommendations. The Review Antimicrobial resistance. HM Government.

- NEW ANTIMICROBIALS
- DETECTION
- INFECTION CONTROL

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ENVIRONMENTAL SURFACES IN HEALTHCARE SETTINGS

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SURFACES & TRANSMISSION

- **1970s - 1990s: THE DARK AGES: AN ALMOST COMPLETE DENIAL!**

EVIDENCE

- **Microorganisms survival on surfaces proximal to patients (high-touch surfaces)**
- **Pathogens survival on surfaces at concentrations sufficient for transmission and transference to the hands of healthcare workers** (inc. MRSA, *C. difficile*, norovirus, VRE…)
- **Low infectious dose for some pathogens**

  Otter *et al. ICHE* 2011;32:687-99.
  Lawley *et al. AEM* 2010;76L6895-900.
  Teunis *et al. J Med Virol* 2008;80:1468-76.
- **Ample evidence of the genotypic link between bacteria isolated from patients and surfaces proximal to patients**

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SURFACES & TRANSMISSION

Environmental contamination with endemic and epidemic MRSA

	Outbreak	Endemic				Site estimated mean§
	Rampling et al[37]*	Boyce et al[48]*	Sexton et al[51]†	Lemmen et al[50]* ‡	French et al[54]*	
Floor	9%	50–55%	44–60%	24%	..	34·5%
Bed linen	..	38–54%	44%	34%	..	41%
Patient gown	..	40–53%	..	34%	..	40·5%
Overbed table	..	18–42%	64–67%	24%	..	40%
Blood pressure cuff	13%	25–33%	..	..	..	21%
Bed or siderails	5%	1–30%	44–60%	21%	43%	27%
Bathroom door handle	..	8–24%	..	12%¶	..	14%
Infusion pump button	13%	7–18%	..	30%	..	19%
Room door handle	11%	4–8%	..	23%	59%	21·5%‖
Furniture	11%	..	44–59%	19%	..	27%
Flat surfaces	7%	..	32–38%	..	..	21·5%
Sink taps or basin fitting	..	..	..	14%	33%	23·5%
Average quoted**	11%	27%	49%	25%	74%	37%

Dancer *et al. Lancet ID* 2008;8(2):101-13

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SURFACES & TRANSMISSION

Survival of pathogens on hospital surfaces

PATHOGEN	SURIVAL TIME
S. aureus (incl. MRSA)	7 days to >12 months
Enterococcus spp. (incl VRE)	5 days to >46 months
Acinetobacter spp.	3 days to 11 months
C. difficile (spores)	> 5 months
Norovirus (& feline calicivirus)	8 h to > 2 weeks
Ps. aeruginosa	6 h to 16 months
Klebsiella spp.	2h to 30 months

Hota *et al. Clin Infect Dis* 2004;39:1182-9
Kramer *et al. BMC Infect Dis* 2006;6:130

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SURFACES & TRANSMISSION

What is clean – visibly clean?

A number of authors proposed that aerobic colony counts on hand-touch sites should be set.

- **a value of < 2.5 CFU/cm² has been proposed based on risk based considerations**
  Griffith *et al. J Hosp Infect* 2000;45:19-28.
  White, et al. AJIC 2008;36:381-4.
  Mulvey et al. J Hosp Infect 2011;77:25-30.
  Meakin et al. J Hosp Infect 2012;80:122-7.
- **a value of <5 CFU/cm² based on ATP levels attainable values**
  Dancer. *J Hosp Infect 2004;56:10-5.*
  Griffith et al. J Hosp Infect 2000;45:19-28.
  Meakin et al. J Hosp Infect 2012;80:122-7.
- **a zero tolerance approach for pathogens; 0 CFU/cm²?**

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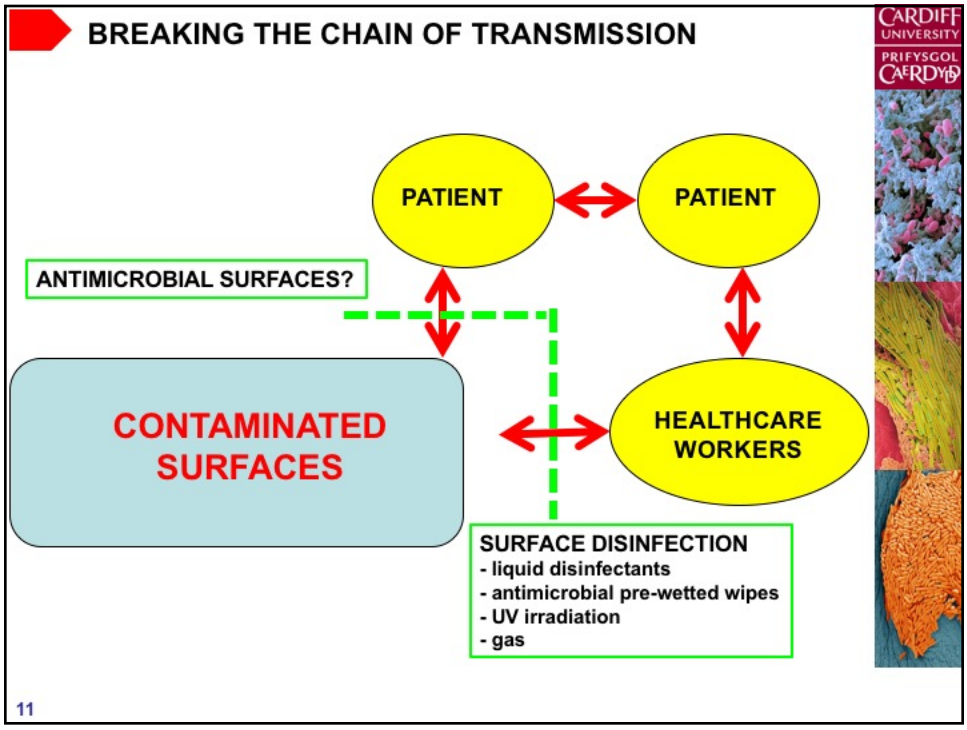
BREAKING THE CHAIN OF TRANSMISSION
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PATIENT
PATIENT
ANTIMICROBIAL SURFACES?
CONTAMINATED SURFACES
HEALTHCARE WORKERS
SURFACE DISINFECTION
- liquid disinfectants
- antimicrobial pre-wetted wipes
- UV irradiation
- gas
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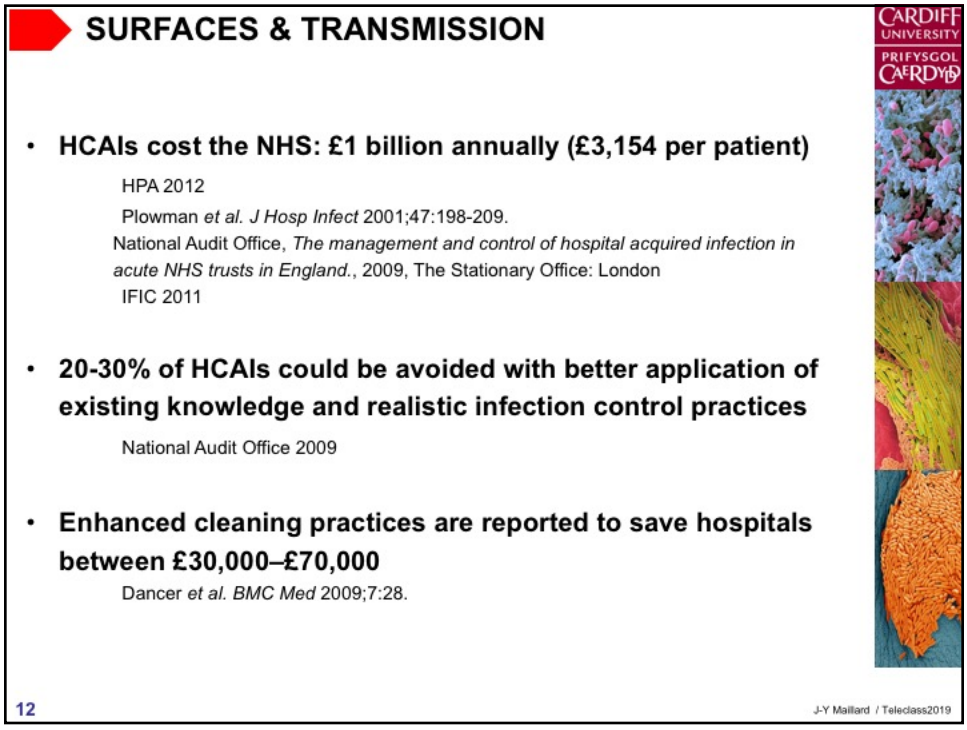
SURFACES & TRANSMISSION
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• HCAIs cost the NHS: £1 billion annually (£3,154 per patient)
HPA 2012
Plowman et al. J Hosp Infect 2001;47:198-209.
National Audit Office, The management and control of hospital acquired infection in acute NHS trusts in England., 2009, The Stationary Office: London
IFIC 2011
• 20-30% of HCAIs could be avoided with better application of existing knowledge and realistic infection control practices
National Audit Office 2009
• Enhanced cleaning practices are reported to save hospitals between £30,000–£70,000
Dancer et al. BMC Med 2009;7:28.
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SURFACES & TRANSMISSION

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Antimicrobial Surfaces

Silver	Copper	Triclosan
Electrical switches	Arms of chair	Cutting boards
Flooring	Bed rails	Plastic lunchboxes
Keyboards	Door handles	Refrigerators
Showers	Door locks	
Waste bins	Door push plates	
Water machines	Dressing trolleys	
Laptop screens	Electrical switches	
Mobile phone screens	Floor drains	
Contact lenses	Handrails	
Paper	IV drip poles	
pens	Keyboards	
	Nurses' call devices	
	Over bed tables	
	Table tops	
	Taps	
	Toilet flush plates	
	Toilet seats	
	Towel rails	






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SURFACES & TRANSMISSION

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Biocidal products for domestic market

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DRY SURFACE
BIOFILMS
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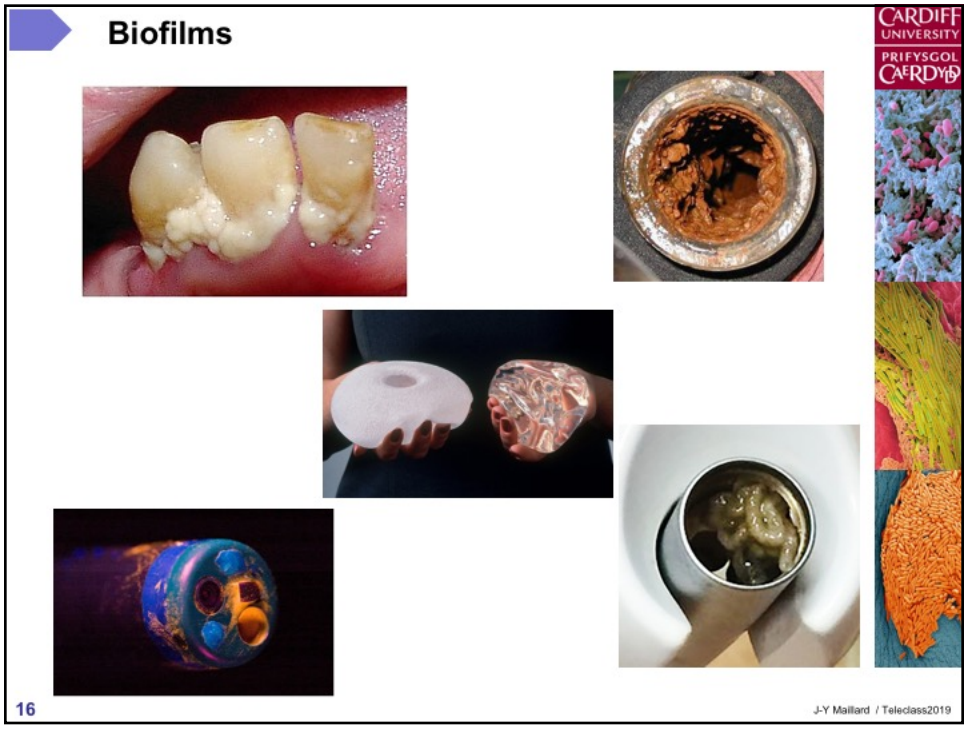
Biofilms
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Environmental biofilms in hospitals

Dry biofilms on hospital surfaces (DSB)

Wet/hydrated biofilms in drain systems

Semi-dry biofilms on medical devices

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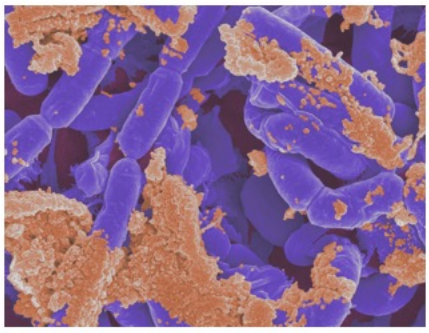
What is dry surface biofilm (DSB)?

- Dry surface biofilms are complex microbial communities formed and grown in dry habitats.
- DSB colonize various materials from textile (chair), hard surfaces including plastic (PVC, PP), lacquered wood, wood, metal (stainless steel) to many others
- Dry biofilms have been isolated from diverse environmental conditions: low moisture, varying temperature and nutrients levels.
- Much less attention has been paid to dry biofilms compared to most commonly researched wet/hydrated biofilms



SEM image of DSB containing mixed hospital culture grown on stainless steel disc

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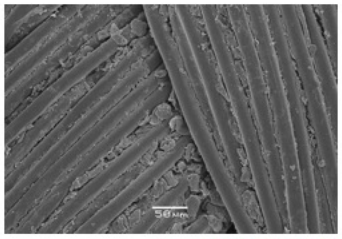
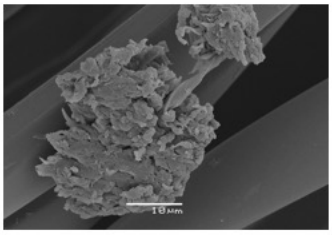
Dry surface biofilms in healthcare settings

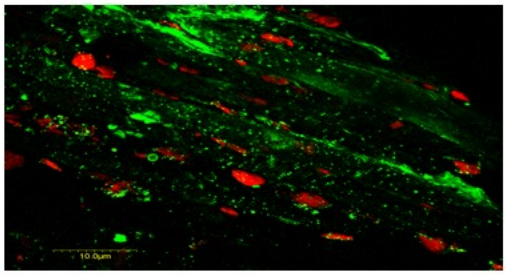
Venetian blind cord MRSA +ve



Curtain – MRSA +ve



Desiccation resistance



Courtesy of K Vickery, Macquarie University, Sydney, Australia

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Dry surface biofilms in healthcare settings

HOSPITAL SURFACE SAMPLES

Samples

Sample processing

- *Sterility* control
- Microbial recovery in enrichment broth
- Partial identification of pathogens on selective agar

Surface disinfection & recovery

- Exposure to chlorine (1,000 ppm) & peracetic acid (30 g/L) for 1 min
- Neutralisation in D/E neutralising broth & recovery at 37°C

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Dry surface biofilms in healthcare settings

Hospital samples

Samples	Colorex^{T} ^{M} MRSA Agar	Colorex^{TM} VRE agar	Colorex^{TM} Acinetobacter agar	Vogel Johnson Agar	MacConkey Agar
Rubber tilt	× (0/3)	× (0/3)	× (0/3)	× (0/3)	✓ (2/3)
Bed frame	× (0/3)	×(0/3)	× (0/3)	✓ (1/3)	✓ (3/3)
Side wheel	✓ (1/3)	× (0/3)	× (0/3)	✓ (1/3)	× (0/3)
Folder-1	✓ (1/3)	× (0/3)	× (0/3)	× (0/3)	× (0/3)
Folder-2	✓ (2/3)	× (0/3)	× (0/3)	✓ (2/3)	✓ (2/3)

Treatment	Rubber tilt	Cable	Bed wheel	Folder-1	Folder-2
Control	✓	✓	✓	✓	✓
Chlorine (1,000 ppm)	✓	✓	✓	✓	✓
Peracetic acid (30g/L)	×	×	×	×	✓

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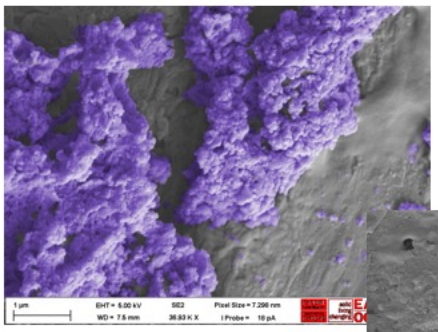
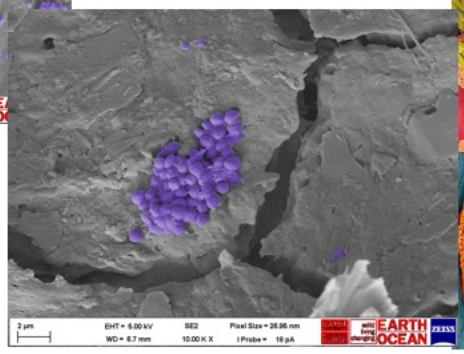
Dry surface biofilms in healthcare settings

Hospital samples



Patients' folder

Commode



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Dry surface biofilms in healthcare settings

Journal of Hospital Infection

Presence of biofilm containing viable multiresistant organisms despite terminal cleaning on clinical surfaces in an intensive care unit

K. Vickery[a,*], A. Deva[a], A. Jacombs[a], J. Allan[a], P. Valente[a], I.B. Gosbell[b,c]

Dry surface biofilms are complex microbial communities formed and grown in dry habitats.

Journal of Hospital Infection

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[g], S. Jensen[f], K. Vickery[a,*]

Dry surface biofilms in healthcare settings

Multi-centre study on dry biofilms from several frequently touch surfaces

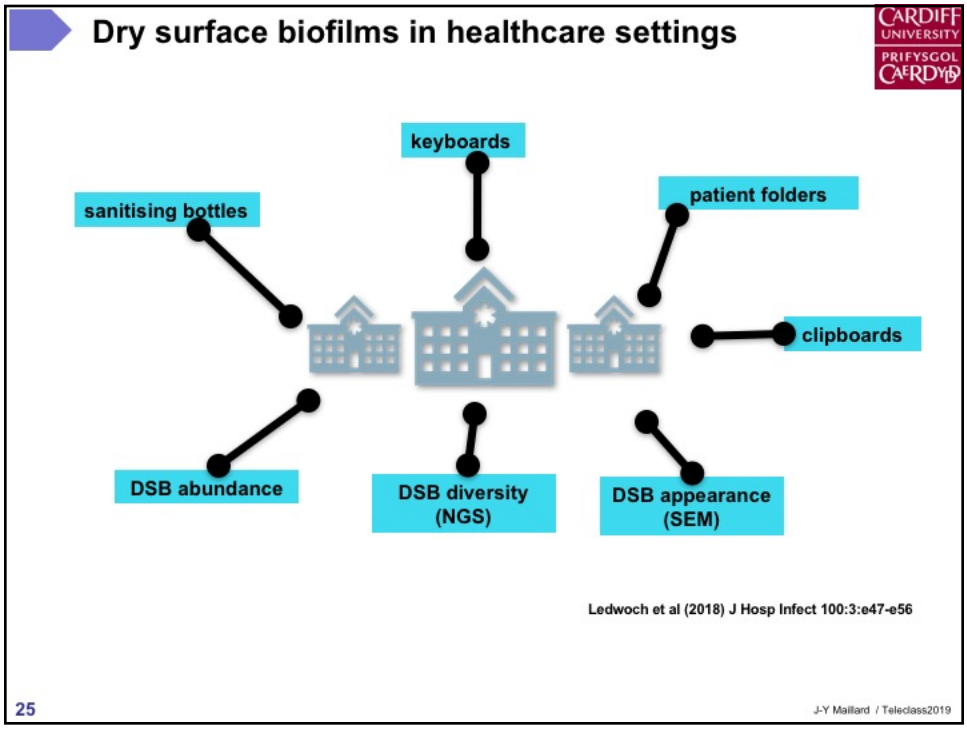
- **3 hospitals** (Wales, England, Scotland)
- **61 samples**

Journal of Hospital Infection

Beware biofilm! Dry biofilms containing bacterial pathogens on multiple healthcare surfaces; a multi-centre study

K. Ledwoch[a], S.J. Dancer[b,c], J.A. Otter[d,e], K. Kerr[a], D. Roposte[a], L. Rushton[f], R. Weiser[f], E. Mahenthiralingam[f], D.D. Muir[g], J.-Y. Maillard[a,*]

Trauma and orthopaedics, adult intensive care, joint assessment unit, acute admission unit, kidney and transplant, nephrology, cardiology, gastroenterology, intensive therapy unit, and haematology


Dry surface biofilms in healthcare settings
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keyboards
sanitising bottles
patient folders
clipboards
DSB abundance
DSB diversity (NGS)
DSB appearance (SEM)
Ledwoch et al (2018) J Hosp Infect 100:3:e47-e56
25
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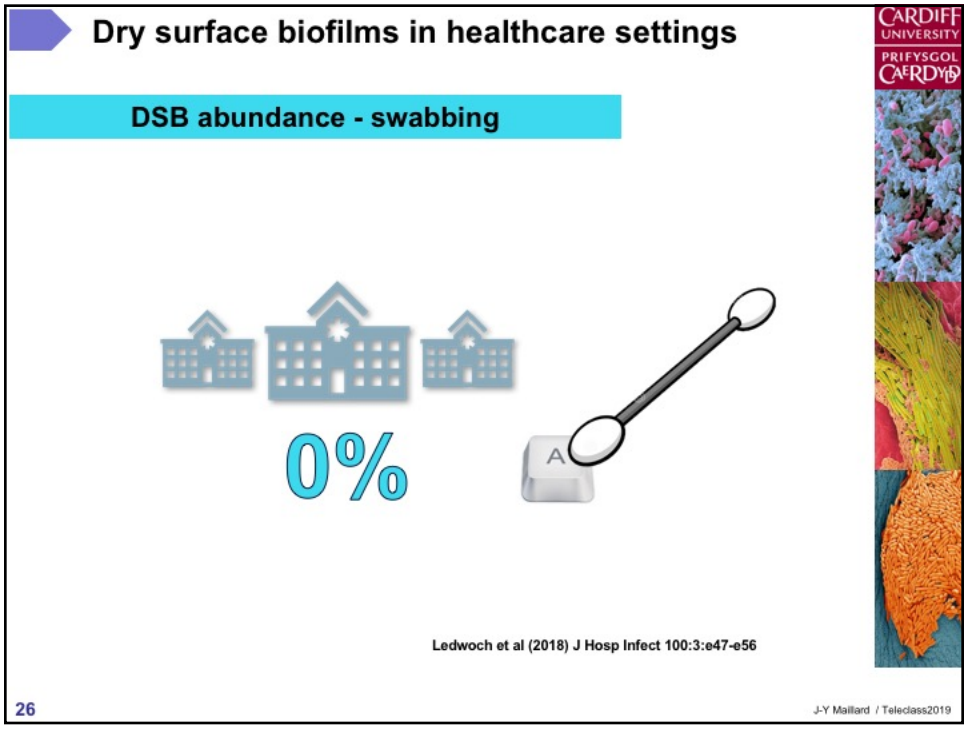
Dry surface biofilms in healthcare settings
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DSB abundance - swabbing
0%
Ledwoch et al (2018) J Hosp Infect 100:3:e47-e56
26
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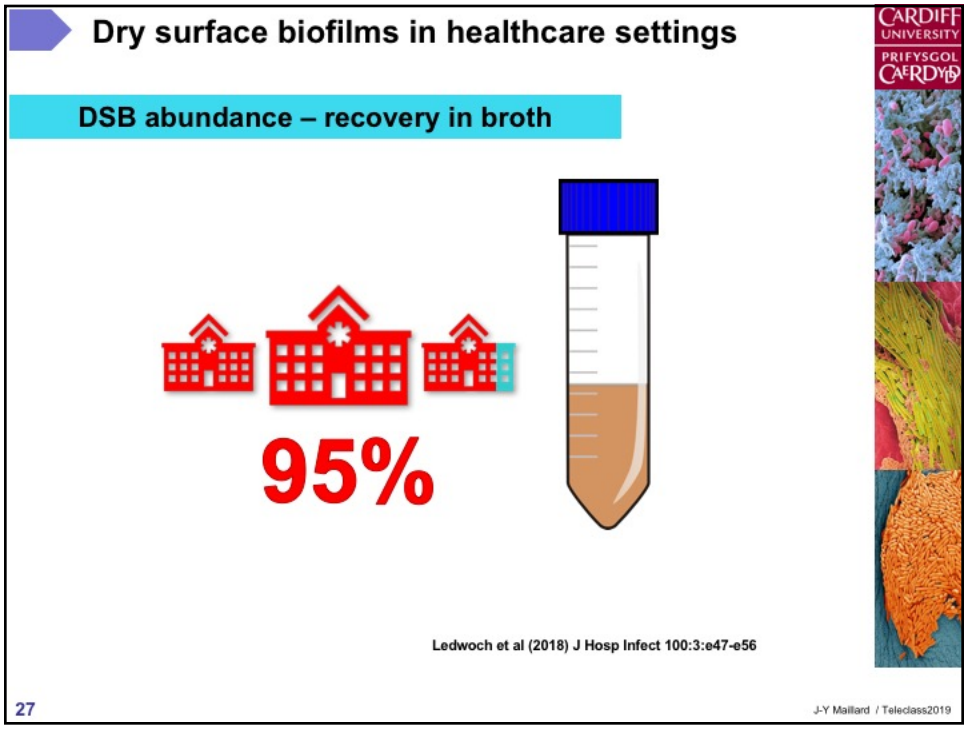
Dry surface biofilms in healthcare settings
DSB abundance – recovery in broth
95%
Ledwoch et al (2018) J Hosp Infect 100:3:e47-e56
27
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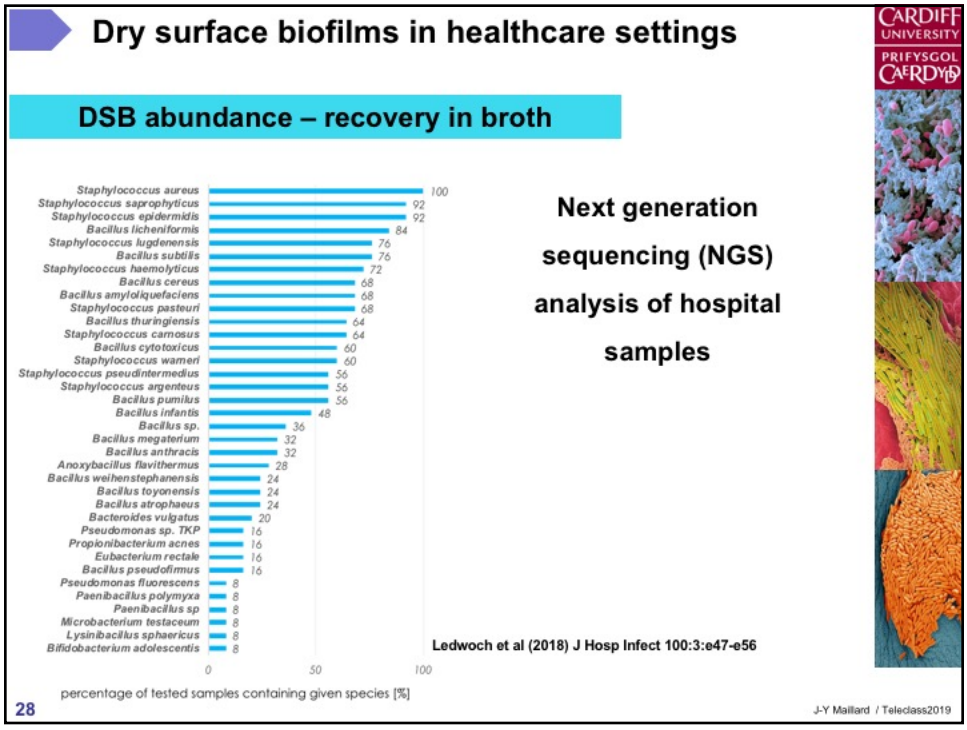
Dry surface biofilms in healthcare settings
DSB abundance – recovery in broth
Staphylococcus aureus 100
Staphylococcus saprophyticus 92
Staphylococcus epidermidis 92
Bacillus licheniformis 84
Staphylococcus lugdenensis 76
Bacillus subtilis 76
Staphylococcus haemolyticus 72
Bacillus cereus 68
Bacillus amyloliquefaciens 68
Staphylococcus pasteuri 68
Bacillus thuringiensis 64
Staphylococcus camosus 64
Bacillus cytotoxicus 60
Staphylococcus wameri 60
Staphylococcus pseudintermedius 56
Staphylococcus argenteus 56
Bacillus pumilus 56
Bacillus infantis 48
Bacillus sp. 36
Bacillus megaterium 32
Bacillus anthracis 32
Anoxybacillus flavithermus 28
Bacillus weihenstephanensis 24
Bacillus toyonensis 24
Bacillus atrophaeus 24
Bacteroides vulgatus 20
Pseudomonas sp. TKP 16
Propionibacterium acnes 16
Eubacterium rectale 16
Bacillus pseudofirmus 16
Pseudomonas fluorescens 8
Paenibacillus polymyxa 8
Paenibacillus sp 8
Microbacterium testaceum 8
Lysinibacillus sphaericus 8
Bifidobacterium adolescentis 8
0
50
100
percentage of tested samples containing given species [%]
Next generation sequencing (NGS) analysis of hospital samples
Ledwoch et al (2018) J Hosp Infect 100:3:e47-e56
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Dry surface biofilms in healthcare settings

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DSB abundance – recovery in broth

A 

Species	%
S. aureus	34.6
S. epidermidis	24.6
B. licheniformis	20.4
S. lugdenensis	5.9
B. subtilis	3.8
B. cereus	3.0
B. thuringiensis	2.3
B. amyloliquefaciens	1.0

B 

Species	%
S. epidermidis	24.2
S. aureus	23.8
B. cereus	9.7
B. licheniformis	9.5
B. thuringiensis	9.1
A. flavithermus	6.3
B. anthracis	3.5
B. subtilis	3.1

C 

Species	%
S. saprophyticus	20.6
B. subtilis	19.1
B. amyloliquefaciens	17.9
B. pumilus	17.6
S. epidermidis	5.7
B. cereus	5.2
S. aureus	4.5
B. thuringiensis	3.5

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Dry surface biofilms in healthcare settings

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DSB appearance: SEM

Image source: https://www.medaptus.com

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Dry surface biofilms in healthcare settings

Image source: Unsplash

- Multi-species dry biofilms were recovered from 95% of samples.
- All biofilms harbored gram-positive bacteria including pathogens associated with HCAIs.
- Dry biofilms had complex composition. Community of 11-27 different microbial species

- DNA of gram negative bacteria was also identified in some of the samples: *Pseudomonas* spp., *Pseudomonas aeruginosa* and *Acinetobacter baumannii*.

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Dry surface biofilms in healthcare settings

Image source: Unsplash

- Multi-species dry biofilms were recovered from 95% of samples.
- All biofilms harbored gram-positive bacteria including pathogens associated with HCAIs.
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- DNA of gram negative bacteria was also identified in some of the samples: *Pseudomonas* spp., *Pseudomonas aeruginosa* and *Acinetobacter baumannii*.

- **Dry biofilms could not be detected by swabbing**

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Why DSB can be a problem?

"(…) hand-touch sites are habitually contaminated by hospital pathogens, which are then delivered to patients on hands"
- Dancer (2009) J Hosp Infect 73: 378-385

"(…) current cleaning practices are inadequate to control biofilm development."
- Vickery et al. (2012) J Hosp Infect 80: 52-55

"Contamination of the inanimate environment around patients constitutes an important reservoir of MRO with the risk of HAI (…)"
- Vickery et al. (2012) J Hosp Infect 80: 52-55

"In 2002, the estimated number of HAIs in U.S. hospitals, (…) was approximately 1.7 million (..). The estimated deaths (…) were 98,987."
-Klevens R, et al. (2007) Public Health Rep 122:160–16

"(…) evaluating the clinical effectiveness of cleaning and disinfecting methods is challenging"
- Han et al. (2015) Ann Intern Med 163(8):598-607

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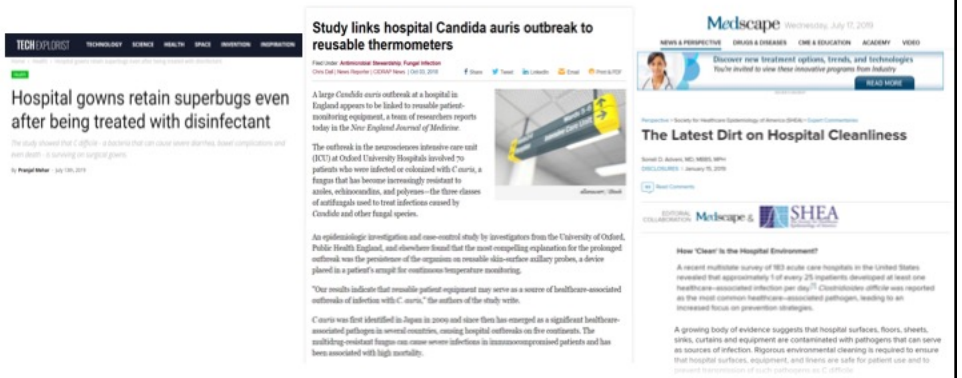
Why DSB can be a problem?



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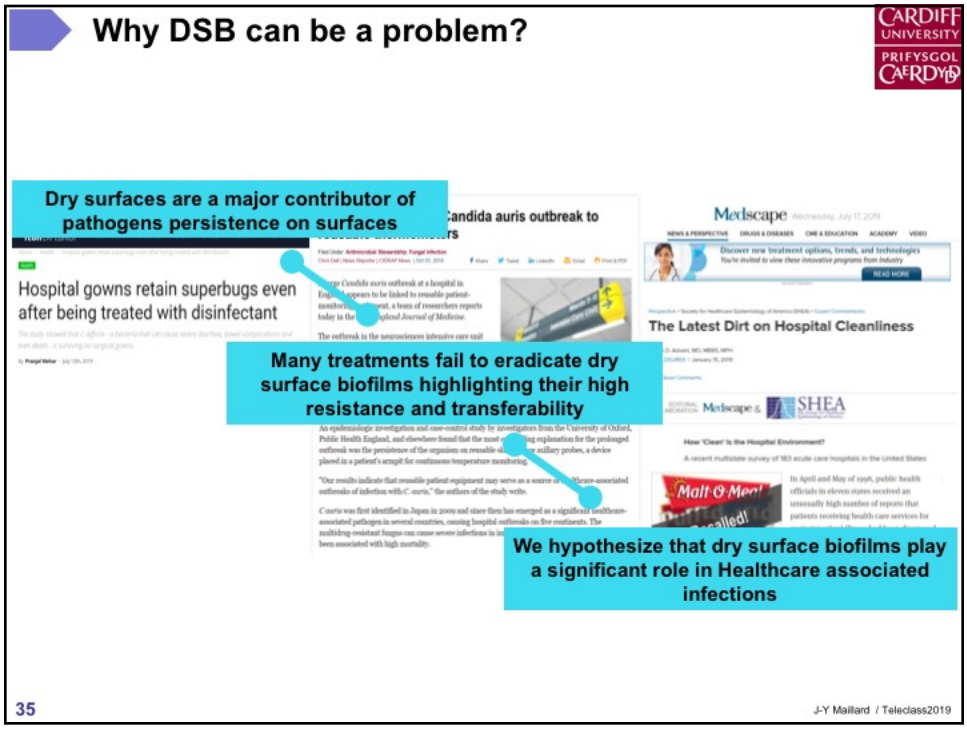
Why DSB can be a problem?
CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD
Dry surfaces are a major contributor of pathogens persistence on surfaces
Hospital gowns retain superbugs even after being treated with disinfectant
Many treatments fail to eradicate dry surface biofilms highlighting their high resistance and transferability
Medscape
The Latest Dirt on Hospital Cleanliness
SHEA
We hypothesize that dry surface biofilms play a significant role in Healthcare associated infections
35
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TESTING SOLUTIONS AGAINST DSB
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Solutions?

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Improved hand hygiene

Image source: Unsplash

Improved cleaning

Image source: http://resistancecontrol.info

Disinfectants targeting DSB

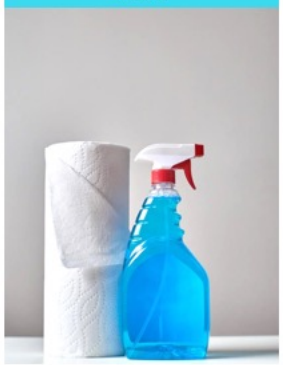

Image source: Unsplash

Image source: Unsplash

Improved monitoring of contamination level

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Dry surface biofilm model

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Day 0	Day 2	Day 4	Day 6	Day 8	Day 10	Day 12
• Inoculation • Wet phase (TSB/ TSB + BSA) • Rotary shaker at room temperature	• Dry phase (media drained out) • Incubation at 37°C/25°C in incubator	• Wet phase (TSB/ TSB + BSA) • Rotary shaker at room temperature	• Dry phase (media drained out) • Incubation at 37°C/25°C in incubator	• Wet phase (TSB/ TSB + BSA) • Rotary shaker at room temperature	• Dry phase (media drained out) • Incubation at 37°C/25°C in incubator	• Dry biofilm is ready for testing

NOW

- ***Staphylococcus aureus***
- ***Candida auris***
- ***Bacillus subtilis***
- ***Bacillus linchenformis***
- ***Klebsiella penumoniae***

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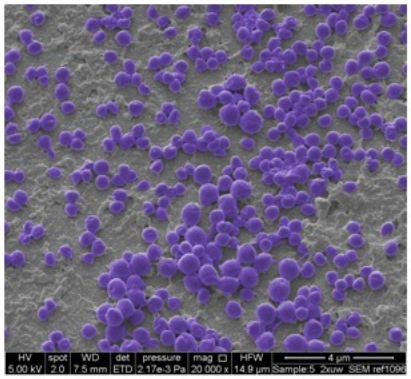
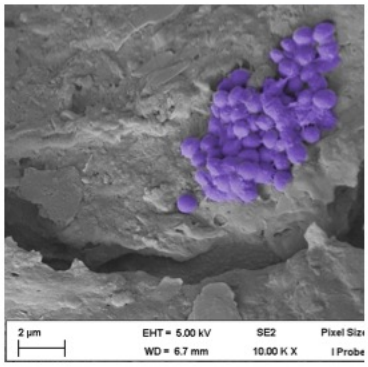
Dry surface biofilm model



Dry artificial biofilm

Environmental biofilm



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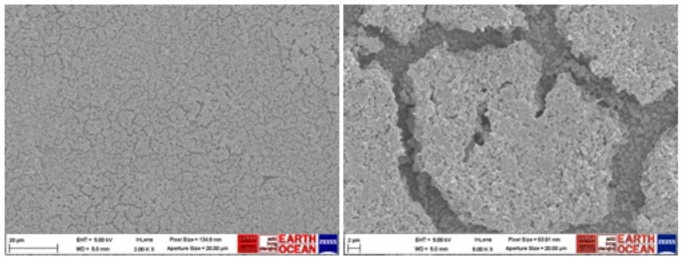
Dry surface biofilm model – *S. aureus*

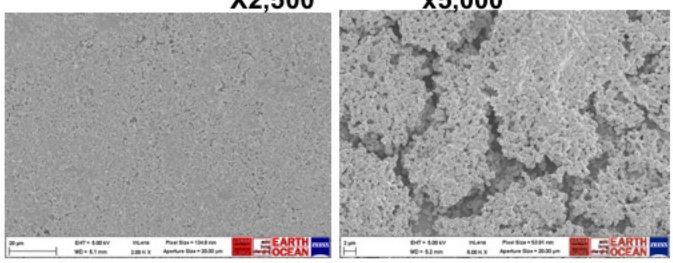
Without organic load

X2,500 x5,000



With organic load

X2,500 x5,000



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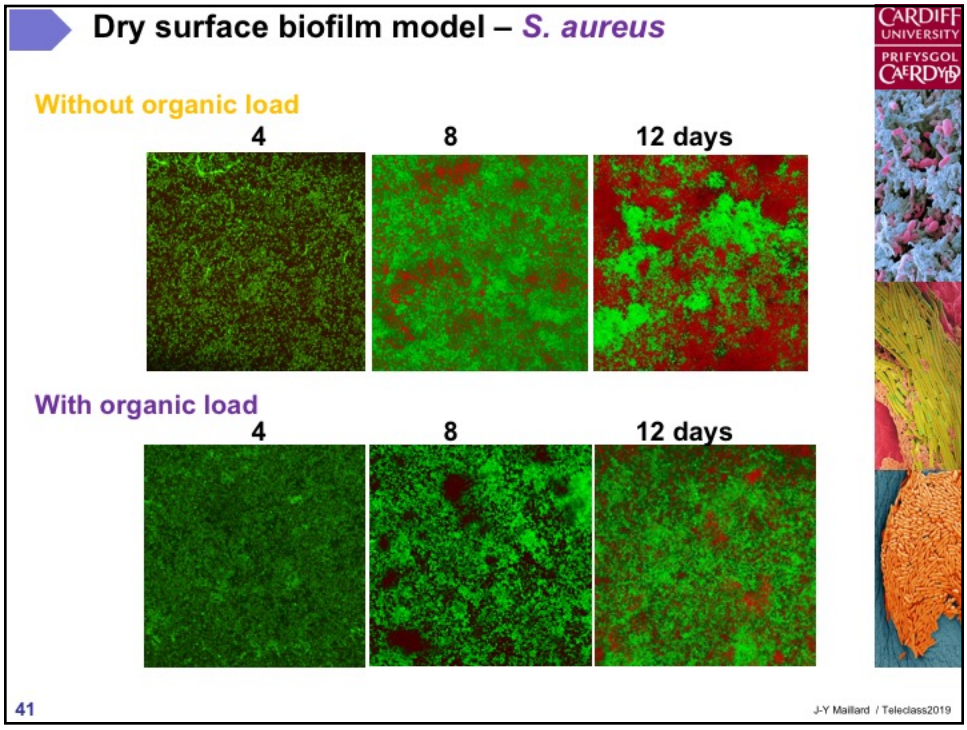
Dry surface biofilm model – S. aureus
CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD
Without organic load
4
8
12 days
With organic load
4
8
12 days
41
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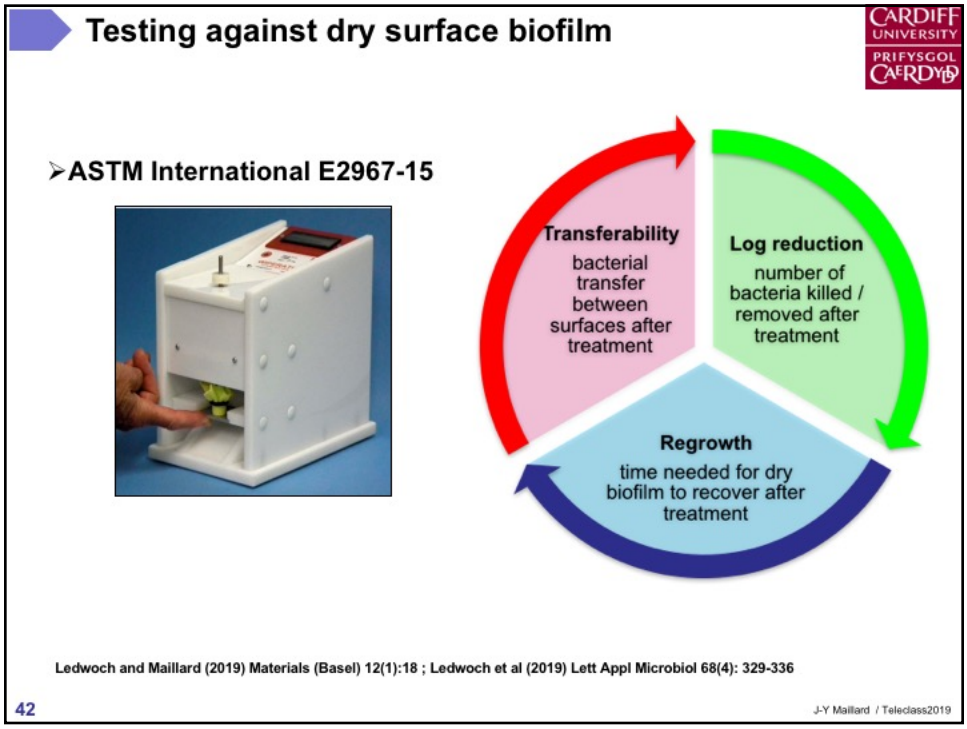
Testing against dry surface biofilm
CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD
ASTM International E2967-15
Transferability
bacterial transfer between surfaces after treatment
Log reduction
number of bacteria killed / removed after treatment
Regrowth
time needed for dry biofilm to recover after treatment
Ledwoch and Maillard (2019) Materials (Basel) 12(1):18 ; Ledwoch et al (2019) Lett Appl Microbiol 68(4): 329-336
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Testing against dry surface biofilm

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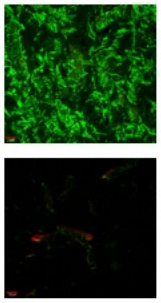
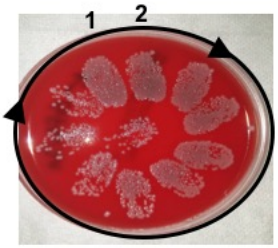
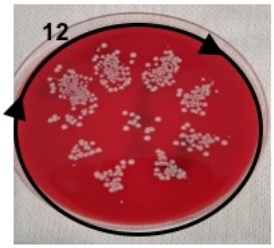
Effect of chlorine on dry biofilm

- 1000 and 5000ppm – recovered 1 day
- 10,000ppm – Recovered after 8 days
- 20,000ppm – Recovered after 12 days







Courtesy of K Vickery, Macquarie University, Sydney, Australia

Transmission following touching a dry biofilm

Testing against dry surface biofilm

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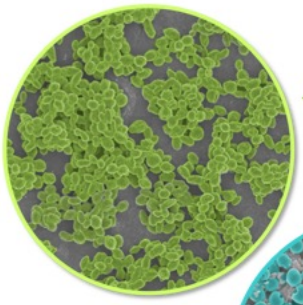
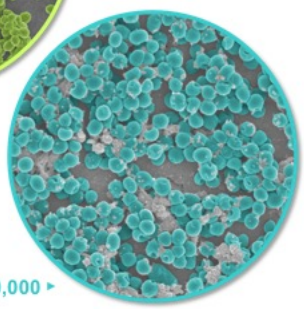
- AISI 430 stainless steel sterile discs
- 10^6 CFU/ml *S. aureus* NCTC 10788
- 10^6 CFU/ml *C. auris* DSM 21092
- 1ml of inoculum per disc
- TSB/MEB + 3 g/L BSA

- 48h wet/dry cycles for of 12 days
- High uniformity ensuring testing repeatability

- More resistant to disinfection treatment than dried bacterial suspension



◂*C. auris* DSB x2,000



S. aureus DSB x10,000 ▸

Treatment efficacy against *S. aureus* DSB

Log_{10} reduction: number of bacteria killed / removed after treatment

Treatment	Log_{10} reduction	
	No OL	OL
Commercial wipe A	3.54	2.68
Commercial wipe B	6.73	3.55
Commercial wipe C	0.25	4.97
Commercial wipe D	**6.87**	**>8.45**
Commercial wipe E	4.65	1.08
NaOCl 1,000ppm	**5.76**	**5.05**
NaDCC 1,000ppm	0.51-4.07	1.58-5.91
ClO_2 200ppm	0	1.69
VH_2O_2	3.08	0.71
Cold gas plasma	6.27	0.84

OL: organic load

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Treatment efficacy against *S. aureus* DSB

Transferability: determines how well bacteria in a dry biofilm can transfer between surfaces post treatment

Treatment	Log_{10} reduction		Transferability	
	No OL	OL	No OL	OL
Commercial wipe A	3.54	2.68	75%	78%
Commercial wipe B	6.73	3.55	31%	33%
Commercial wipe C	0.25	4.97	100%	85%
Commercial wipe D	**6.87**	**>8.45**	**8%**	**1%**
Commercial wipe E	4.65	1.08	39%	50%
NaOCl 1,000ppm	**5.76**	**5.05**	**44%**	**100%**
NaDCC 1,000ppm	0.51-4.07	1.58-5.91	100%	69-100%
ClO_2 200ppm	0	1.69	100%	100%
VH_2O_2	3.08	0.71	67%	100%
Cold gas plasma	6.27	0.84	19%	100%

OL: organic load

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Treatment efficacy against *S. aureus* DSB

Regrowth: time needed for a dry biofilm to recover after treatment

Treatment	Log_{10} reduction		Transferability		Regrowth (days)	
	No OL	OL	No OL	OL	No OL	OL
Commercial wipe A	3.54	2.68	75%	78%	3.9	2
Commercial wipe B	6.73	3.55	31%	33%	6.2	5
Commercial wipe C	0.25	4.97	100%	85%	1.3	2
Commercial wipe D	6.87	>8.45	8%	1%	>2	4.3
Commercial wipe E	4.65	1.08	39%	50%	>1.5	1.3
NaOCl 1,000ppm	5.76	5.05	44%	100%	4.8	3.9
NaDCC 1,000ppm	0.51-4.07	1.58-5.91	100%	69-100%	1.3-1.7	1-2
ClO_2 200ppm	0	1.69	100%	100%	1	1
VH_2O_2	3.08	0.71	67%	100%	1.4	1.1
Cold gas plasma	6.27	0.84	19%	100%	2.5	1

OL: organic load

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Development of a dry biofilm model – *C. auris*

Materials **2019**, *12*(1), 18; https://doi.org/10.3390/ma12010018 Open Access Article

***Candida auris* Dry Surface Biofilm (DSB) for Disinfectant Efficacy Testing**

Katarzyna Ledwoch and **Jean-Yves Maillard** *

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(This article belongs to the Special Issue Microbial Biofilms in Healthcare: Formation, Prevention and Treatment)

Full-Text | PDF [1428 KB, uploaded 21 December 2018] | Figures | Review Reports

Abstract

Candida auris is an emerging pathogen that needs to be controlled effectively due to its association with a high mortality rate. The presence of biofilms on dry surfaces has been shown to be widespread in healthcare settings. We produced a *C. auris* dry surface biofilm (DSB) on stainless steel surfaces following sequential hydration and desiccation cycles for 12 days. The ASTM2967-15 was used to measure the reduction in viability of 12 commercially wipe-based disinfectants and sodium hypochlorite (1000 ppm) against *C. auris* DSB. We also evaluated *C. auris* transferability and biofilm regrowth post-treatment. A peracetic acid (3500 ppm) product and two chlorine-based products (1000 ppm available chlorine) were successful in reducing *C. auris* viability and delaying DSB regrowth. However, 50% of the products tested failed to decrease *C. auris* viability, 58% failed to prevent its transferability, and 75% did not delay biofilm regrowth. Using three different parameters to measure product efficacy provided a practical evaluation of product effectiveness against *C. auris* DSB. Although log_{10} reduction in viability is traditionally measured, transferability is an important factor to consider from an infection control and prevention point of view as it allows for determination of whether the surface is safe to touch by patients and hospital staff post-treatment. View Full-Text

Keywords: *Candida auris*; dry-biofilm; disinfection; peracetic acid; sodium hypochlorite; chlorine dioxide; sodium dichloroisocyanurate; transferability; regrowth

▼ Figures

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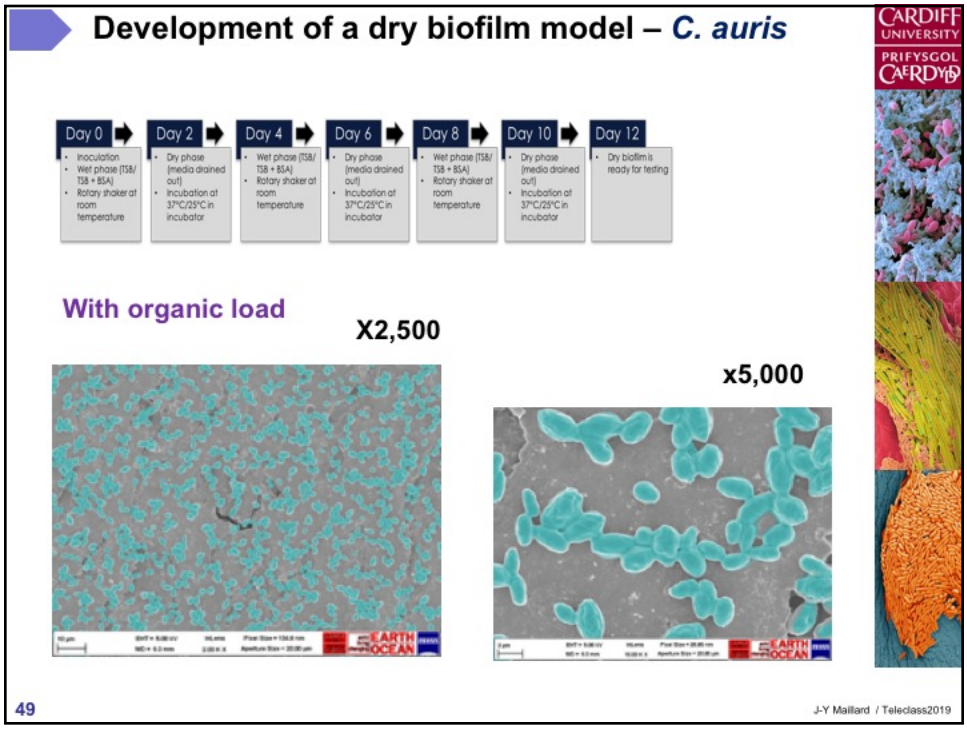
Development of a dry biofilm model – C. auris
Day 0
Inoculation
Wet phase (TSB/ TSB + BSA)
Rotary shaker at room temperature
Day 2
Dry phase (media drained out)
Incubation at 37°C/25°C in incubator
Day 4
Wet phase (TSB/ TSB + BSA)
Rotary shaker at room temperature
Day 6
Dry phase (media drained out)
Incubation at 37°C/25°C in incubator
Day 8
Wet phase (TSB/ TSB + BSA)
Rotary shaker at room temperature
Day 10
Dry phase (media drained out)
Incubation at 37°C/25°C in incubator
Day 12
Dry biofilm is ready for testing
With organic load
X2,500
x5,000
CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD
49
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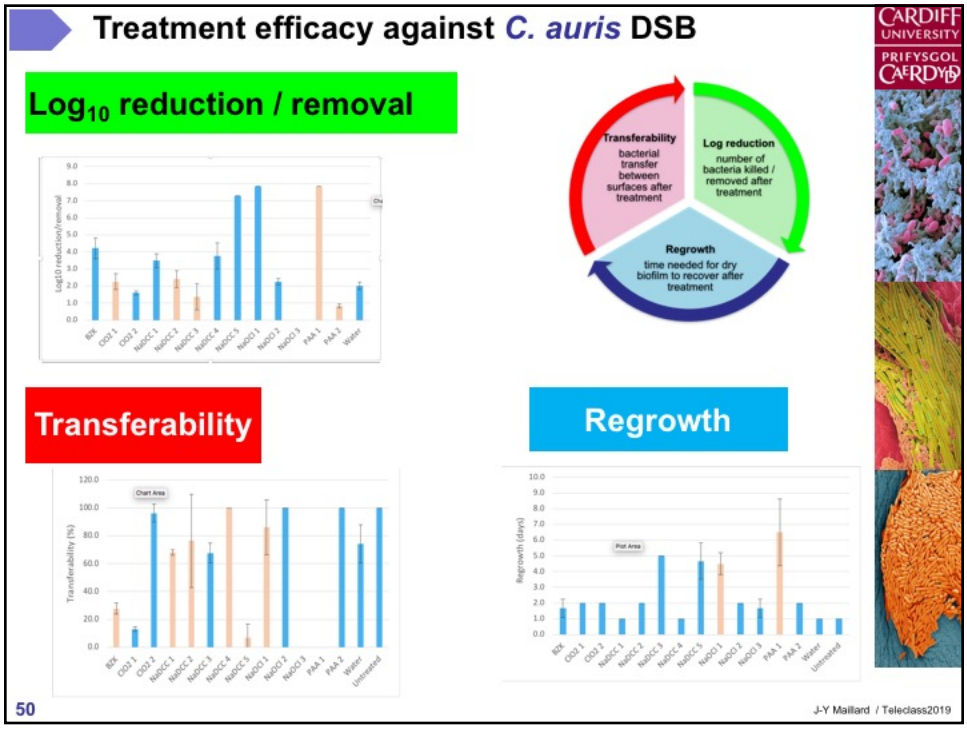
Treatment efficacy against C. auris DSB
Log10 reduction / removal
Transferability
bacterial transfer between surfaces after treatment
Log reduction
number of bacteria killed / removed after treatment
Regrowth
time needed for dry biofilm to recover after treatment
Transferability
Regrowth
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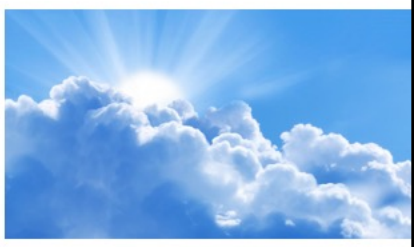
DSB KNOWLEDGE



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BEWARE OF DRY BIOFILMS

Dry biofilms on hospital surfaces (DSB)

- Widespread on environmental (dry) surfaces
- Cannot be detected by swabbing (of dry surfaces)
- Less susceptible to biocidal products if no mechanical removal
- Can easily be transferred post-treatment (when wet)
- Product formulation matters

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BEWARE OF DRY BIOFILMS

Dry biofilms on hospital surfaces (DSB)

- Contribute to HCAI?
- Difficult to eradicate
- Patients and staff directly exposed
- Harbor pathogens
- Require improved control measures

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THANK YOU

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Are Towelettes Effective for Surface Decontamination in Healthcare Settings?
Prof. Jean-Yves Maillard, Cardiff University, Wales
A Webber Training Teleclass

www.webbertraining.com/schedulep1.php	
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