The World Needs Clean Hospitals
Dr. Stephanie Dancer, NHS Scotland
Broadcast live from the Australasian College of Infection Prevention and Control

"Traditional environment-based hospital hygiene has long been considered a weak science........
usually arising from the creation of a global hypothesis.............
......poetically elaborated upon by its creator....
without any appeal to patient-orientated facts that would be capable of confirming or refuting it"

Harbarth S, Lowbury Lecture 2012

Who says patients don’t know whether a hospital is clean or not?
Patient’s non-evidence based perceptions are associated with objective measures of hospital quality

Evidence from the USA
Patient’s perceptions of room cleanliness are associated with infection and mortality rates from 87 hospitals
Trucano & Kaldenberg, Pt Safety & Qual Healthcare 2007

Evidence from the UK
Better web-based patient ratings of hospital cleanliness were associated with lower MRSA (p<0.001) and C. difficile (p=0.04) infection rates per 1000 bed-days
Greaves et al, Arch Intern Med 2012

Properties of hospital pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Survival time</th>
<th>Infectious dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>7 days to &gt;7 months</td>
<td>4 cfu/s</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>3 days to &gt;5 months</td>
<td>250 cfu/s</td>
</tr>
<tr>
<td>C. difficile</td>
<td>&gt;5 months</td>
<td>5 spores</td>
</tr>
<tr>
<td>VRE</td>
<td>5 days to &gt;4 months</td>
<td>&lt;10^4 cfu/s</td>
</tr>
<tr>
<td>E. coli</td>
<td>2 hrs to 16 months</td>
<td>10^2-10^6 cfu/s</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>2 hrs to &gt;30 months</td>
<td>10^4 cfu/s</td>
</tr>
<tr>
<td>Norovirus</td>
<td>8 hrs to 7 days</td>
<td>&lt;20 virions</td>
</tr>
</tbody>
</table>

Kramer, BMC Infect Dis, 2006; Wagenhoft, JHI 2000; Chiang, Crit Care Med 2005;
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It's just as easy to pick up microbes from the environment as it is from the patient

...and the next patient in this room is also at risk

Increased infection risk associated with prior room occupant
Figures of difference in risk are unadjusted from raw data

MRSAs (Huang et al.)
VRE (Huang et al.)
P. aeruginosa (Nee et al.)
VRE (2 weeks) (Crews et al.)
VRE (Crews et al.)
C. difficile (Shaughnessy et al.)
A. baumannii (Nee et al.)

Difference in risk

Isn't this a measure of environmental longevity?

Otter et al, Am J Infect Control 2012; 41: 58 - 57

How good is the cleaning in your hospital?
Fluorescent gel placed on chosen sites
After patient discharge, a site is considered cleaned if the fluorescent material is removed or disrupted

Removal of marker may not correlate with cleaning of related sites on the same surface

Sitzlar et al, ICHE 2013

How do we measure hospital cleanliness?

82-91% Visually clean
10-24% ATP clean
30-45% Microbiologically clean

What's the long term effect?

Maintenance of environmental services cleaning and disinfection in the ICU after a performance improvement project

Fitzgerald et al, AmJIC 2012

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Surface evaluation using ATP bioluminescence

Swab surface → luciferase tagging of ATP → Luminometer

Used in the commercial food preparation industry to evaluate surface cleaning and as an educational tool

ATP values (RLU’s) for sites on medical & surgical wards

<table>
<thead>
<tr>
<th>Site</th>
<th>Before</th>
<th>After</th>
<th>Site Mean ATP Before</th>
<th>Site Mean ATP After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locker (M)</td>
<td>19-304</td>
<td>17-148</td>
<td>173</td>
<td></td>
</tr>
<tr>
<td>Locker (S)</td>
<td>3-328</td>
<td>134</td>
<td>208</td>
<td></td>
</tr>
<tr>
<td>L Bed (M)</td>
<td>6-243</td>
<td>6-1512</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>L Bed (S)</td>
<td>0-145</td>
<td>52-115</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>G/B Table (M)</td>
<td>26-425</td>
<td>13-75</td>
<td>181</td>
<td></td>
</tr>
<tr>
<td>G/B Table (S)</td>
<td>5-559</td>
<td>55-3614</td>
<td>309</td>
<td></td>
</tr>
<tr>
<td>R Bed (M)</td>
<td>0-499</td>
<td>5-200</td>
<td>412</td>
<td></td>
</tr>
<tr>
<td>R Bed (S)</td>
<td>118</td>
<td>16-128</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

Mulvey et al., JIS 2011

Would microbiological standards help?

5 cfu/cm²
45 cfu/cm²

Slide from Chris Griffith

Microbiological standards for hospital surfaces

Standard 1
There should be <1 cfu/cm² pathogen (MRSA; C.difficile; VRE; etc) in the clinical environment

Standard 2
Aerobic Colony Count (ACC) from a hand contact surface should be <5 cfu/cm²

These standards are based upon food industry counts as applied to food preparation surfaces but could be utilised for frequent hand-touch surfaces in hospitals

Dancer S, J Hosp Infect 2004

Dirt, busy wards and risk

High aerobic colony counts at a hand-touch site is significantly associated with finding S.aureus & MRSA at that site (p=0.001);
……and there is a significant association between high counts and bed occupancy


Application of cleaning standards on ICU

25% of 200 samples failed the standards, mostly hand-touch sites
Hygiene fails were associated with bed occupancy and incidence of ICU-acquired infection
Hygiene standards reflect patient activity and provide a means to risk manage infection

White et al., AmJIC, 2008

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Is there a relationship between environmental bioburden and hospital-acquired infection?

Isolation of pathogens from environmental surfaces causes concern
Environmental surface-sampling only likely to be used in response to an outbreak

Lessons from the food industry
Comparison of approaches to monitoring cleaning efficacy between food and healthcare industries.

Environmental sampling is important
One study suggests that if an organism is found in the food preparation environment, there is a 70% chance of it getting into the food....

Does extra cleaning have an effect on MRSA?
Two acute surgical wards received targeted (high-touch near-patient) cleaning from Monday to Friday, with each ward receiving extra cleaning for six months in a prospective cross-over design over 1 year

Patient and environmental MRSA isolates were characterized using CHEF PFGE with CHEF-mapper system
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Impact of cleaning and other interventions on *C. difficile*

Effect of cleaning surfaces & hands on VRE

Controlling pan-drug resistant *A. baumanii* in ICU

The Hand-Touch equation

- decreased surface contamination with VRE;
- less frequent VRE contaminated HCW hands
- a significant reduction in VRE cross-transmission

Hayden et al, CID 2006

Hand

Hand-touch site

WHY….is all the emphasis on cleaning hands, and not on the surfaces that they touch?

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**What do most successful cleaning interventions have in common?**

Cleaners were subjected to some type of performance monitoring!
Observation; supervision; environmental screening; covert fluorescent tagging of surfaces; feedback & education, etc

Hota et al, J Hosp Infect 2009; Guerrero et al, ICHE 2013

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Hawthorne effect is readily seen from cleaning staff.....

"Why aren’t we achieving better results? A literature review of HAI interventions.”

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**Who cleans what? And how often?**

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**How long do hospital surfaces stay ‘clean’?**

Contact plates from patient locker surface
Left to right: Pre clean, 1 hour, 2 hour, 3 hour assessment

MRSA rapidly recontaminates high-touch sites after cleaning

Hardy KJ et al, JHI 2007

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Disinfectant cleaning reduces microbial soil on beds.....

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...but not for long!

Attaway et al, AmJC 2012

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**Effect of three detergent cleans on total aerobic colony counts from 120 hand-touch sites on a 30 bed ward over 48 hours**

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**Effect of detergent and disinfectant cleaning on total MSSA/MRSA recovered from hand-touch sites on one 30 bed ward over 48 hours**

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Time to get PHYSICAL!
Satter & Malland, Am JIC 2013

C.difficile and cleaning – alternative options to using chlorine-releasing disinfectants……could C.difficile be removed by routine physical cleaning?
Awwadil-Karim et al, J Hosp Infect 2011

A single clean can reduce contamination by around 90%....
Spear et al, J Hosp Infect 2011

When surfaces are wiped 3 or more times, detergent wipes are just as effective as disinfectant wipes
Speight et al, J Hosp Infect 2011

Physical removal of C.difficile spores is more important than sporicidal inactivation
Rutala et al, ICHE 2012

How should we clean clinical equipment?
Three methods:
1. Disposable barrier
2. Detergent
3. Disinfection with 1/10 dilution of 5% sodium hypochlorite

Awadel-Kariem et al, J Hosp Infect 2011

All three protocols decreased MRSA surface load by >99%
from 10-14 cfu/cm² to 0.1 cfu/cm² (p<0.001)
Petti et al, AmJIC 2012

Cleaning in the 21st century: what’s best?

Detergent!
Targeted!
Frequently!

...but we STILL need practical standards for surface level cleanliness in hospitals that reflect clinical risk

Floor wars: the battle for ‘clean’ surfaces....
Dancer SJ, J Hosp Infect 2013

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NB. No disclosures

Thank you!
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