Infection Control in the 21st Century
Dr. Stephanie Dancer, NHS Lankashire
Broadcast live from the 2014 Infection Prevention Society conference

If we only had eyes to see........
...what would we see?

‘Hospital infection: From Macnas to MRSA’, Aylliffe & English, 2003

Properties of hospital pathogens

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Survival time</th>
<th>Infectious dose</th>
<th>Reservoir</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>7 days-7 mths</td>
<td>4 cfu’s</td>
<td>Hand; dust; air</td>
</tr>
<tr>
<td>Acinetobacter</td>
<td>3 days-5 mths</td>
<td>250 cfu’s</td>
<td>Dust; hand; air</td>
</tr>
<tr>
<td>C.difficile</td>
<td>&gt;5 mths</td>
<td>7 spores</td>
<td>Dust; hand; air</td>
</tr>
<tr>
<td>VRE</td>
<td>5 days-4 mths</td>
<td>&lt;10^1 cfu’s</td>
<td>Dust; hand; air</td>
</tr>
<tr>
<td>E. coli</td>
<td>2 hrs-16 mths</td>
<td>10^3-10^6 cfu's</td>
<td>Hand; water; air</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>2 hrs-30 mths</td>
<td>10^6 cfu's</td>
<td>Hand; water; air</td>
</tr>
<tr>
<td>Norovirus</td>
<td>8 hours-7 days</td>
<td>&lt;20 virions</td>
<td>Air; hand; food</td>
</tr>
</tbody>
</table>

Kramer, BMC Infect Dis, 2006

Epidemiology = Reservoirs + Routes of transmission

http://www.nursingscp.com/courses/375/index.ncou.html

It’s not just infection ‘control’ anymore...

Mortality rates of staphylococcal bacteraemia over time

Data taken from Rubin et al., Enrrg Infect Dis 1996; Congreve et al, CID 2003; and Fradin et al, CID 2003. Update from van Hal et al, CMR 2013

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What's beneath the Infection Prevention Umbrella?

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand transmission</td>
<td>Hand hygiene</td>
</tr>
<tr>
<td>Contaminated environment</td>
<td>Clearing</td>
</tr>
<tr>
<td>Airborne pathogens</td>
<td>Ventilation</td>
</tr>
<tr>
<td>Infected patient</td>
<td>Isolation</td>
</tr>
<tr>
<td>Patient at risk</td>
<td>Screening</td>
</tr>
<tr>
<td>Medical equipment</td>
<td>Decontamination</td>
</tr>
<tr>
<td>Hospital-acquired infection</td>
<td>Surveillance</td>
</tr>
<tr>
<td>Drug resistance</td>
<td>Antimicrobial stewardship</td>
</tr>
<tr>
<td>Infection control service</td>
<td>Infection control team</td>
</tr>
</tbody>
</table>


Recognising the conflict between healthcare funding and infection control

"...patients don’t fit into packets; the patient journey isn’t a production line...."

...even simple control measures do not necessarily happen on the shop floor

Why doesn’t hand hygiene work better? Sadowitz K, Lancet Infect Dis 2012

What constitutes effective infection control?

Screening and isolation to control MRSA: sense, nonsense, and evidence, Fähnkeuer et al, The Lancet, 21st August 2014

"There is nothing wrong with lessons learned from the past, other than 21st century arrogance in forgetting them" Dancer SJ, BMI Rapid Response 2008

Seeing is believing

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Let's talk about S.aureus
Outbreak in Guy's Hospital neonatal unit, London 1989

S.aureus outbreak among neonates, London 1988

Whole-genome sequencing for analysing an outbreak of PVL-MRSA

Decreasing MRSA due solely to ‘splash-and-go’?

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"Screening of hospital staff for Staphylococcus aureus", Aylliffe GA, Nurs Times 1978

S. aureus dispersal from nasal & perineal carriers

"Wound infections acquired from a disperser of an unusual strain of Staphylococcus aureus", Aylliffe & Collins, J Clin Path 1967

"Nasal, axillary, and perineal carriage of Staphylococcus aureus among women", Dancer & Noble, J Clin Path 1992

Did you know that your choice of underwear could be an infection control risk?

It is only a matter of time before we are all forced to wear elasticated pants.


Bacterial contamination of white coats......

Stethoscopes, pens, cuffs, ties, rings, watches, and so on

Let’s get rid of them!

Gotta be Bare Below The Elbows!

"Pants, Pockets and Parasites", Dancer SJ, J Hosp Infect 2010

"Contamination of protective clothing and nurses’ uniforms in an isolation ward", Siddi JR, Davies JB & Aylliffe GA, J Hosp Infect 1983

(Personal) Hygiene is key

"Put your ties back on: scruffy doctors damage our reputation and indicate a decline in hygiene", Dancer SJ, BMJ 2013

The Hand-Touch equation

Hand = Hand-touch site

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

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MDR Enterobacter cloacae outbreak in ITU associated with contaminated foam mattresses

One E. cloacae clone type found with:
four environmental isolates (lanes 1–4) and six clinical isolates (lanes 5–7, 9, 11 and 18)

van der Mee-Marcqut et al., CFE Care 2006

"Gentamicin-resistant Pseudomonas aeruginosa infection from mattresses in a burns unit", Fujita, Lilly, Kishen & Ayllon GA, BMJ 1992

Such a fuss over the importance of basic cleaning...

White et al, AnnIC 2006

"Word floors and other surfaces as reservoirs of hospital infection", Ayllon GA et al, J Hosp Infect 1997

Persistence of mixed staphylococcal assemblages following disinfection of hospital room surfaces

Brackets above PCR fingerprints indicate paired samples collected from the same surface before and after cleaning
Siby & Henley, JIH 2012

Molecular relationships between patient & environmental MRSA

Dancer et al, JIMC Med 2009

Disinfect everything.....

"Routine surface disinfection in healthcare facilities: should we do it?”, Allerberger, Ayllon et al, Am J Infect Control 2002

Time to get PHYSICAL!

C.difficile and cleaning – alternative options to using chlorine-releasing disinfectants......could C.difficile be removed by routine physical cleaning?

Awards-Krueger et al, J Hosp Infect 2011

When surfaces are wiped 3 or more times, detergent wipes are just as effective as disinfectant wipes
Beverd et al, AvM 2011

Two step cleaning is no more effective than one-step cleaning
Gilliland et al, AvM 2011

A single clean can reduce contamination by around 90%.....

Spriggt et al, J Hosp Infect 2011

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

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Detergent vs disinfectant-based cleaning on total MSSA/MRSA recovered from near-patient sites on one ward over 48 hours

Stewart et al. ICHE in press 2014

Antimicrobial surfaces
In a world first, IT suites in Finland’s Jorvi Hospital have been coated with antimicrobial copper equipment to reduce the risk of infections spreading via frequently touched surfaces
www.cleanroomtechnology.com, 23rd January 2014

Desks and keyboards used by staff on an emergency ward were replaced with copper and copper-alloy products


‘The restricted use of antibiotics, especially third generation cephalosporins, is another possible reason... for the low number of MRSA isolates in some countries’...

‘...third generation cephalosporins, and more recently, the quinolones may have had a selective influence ... in the increasing incidence of MRSA...’

‘How antibiotics can make us sick: the less obvious adverse effects of antimicrobial chemotherapy’, Dancer SJ, Lancet Infect Dis 2004

‘Licence to prescribe’?

‘Hospital disinfectant and antibiotic policies’, Aylfie GA, Chemoterapia 1987


Protective isolation in single-bed rooms: studies in a modified hospital ward
Aylfie et al, J Hosp (London), 1971

‘Detailed specifications needed to prevent airborne dispersal of pathogens are still unknown’

‘Roles of sunlight and natural ventilation for controlling infection’, Nobayda RA & Dancer SJ, J Hosp Infect 2013

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Germicidal effects of sunlight

Previous work confirms the germicidal effects of sunlight, with unexplored earlier studies suggesting a potential role for surface decontamination.

Exposure to sunlight may enhance resistance to infection in those who receive it, even from behind glass.


Healthcare

Electronic hand hygiene monitor
E-prescribing
Global surveillance, with definitions
Electronic ‘reuse’, glowing wounds
Bacterial interference... probiotics
Phage therapy
New vaccines; new anti-infectives
Hospital design: ventilation, UV light
Decontamination ‘Teddi’ & ‘Robots’

Community

‘Find & Treat’ TB vars... or sniff it out?
Promote hygiene — education, media
Drains and sewage
Farm-to-fork: bio-coated wrappers
Animals & agriculture
Quarantine; imprisonment?
Soil searching

Hospital of the future

Infection control in the 21st century

It’s not about antibiotics any more;
It’s about transmission and how to stop spread

Farewell antibiotics....

Hello Hygiene

Dancer SJ, BMJ June 2013

Infection control in the 21st century?

...it’s in YOUR hands!

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Acknowledgements

- Hairmyres Microbiology
- Professor Cedric Mims
- Sister Anne Crawford, ICN
- Sister Jennifer East, ICN
- Professor Chris Robertson
- Dr Colin Macduff & the VisinVis team
- Raymond Hamill, R&D director, NHS Lanarkshire
- Professor Graham Ayliffe
- www.staggeringstories.net (previous slide)

NB: No relevant disclosures, no shares, no shady deals

NHS Scotland takes steam cleaning to a new level

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