Cleaning the "Grey Zones" of Hospitals

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Hosted by Paul Webber
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Disclosures

- Funding from GSK and Pfizer for investigator-initiated research studies (on flu and CAP)
- In-kind contribution from Biomerieux (for research on Hospital Associated Infections in Ethiopia)
- In-kind contribution from Clorox (for environmental cleaning study at St Mary's Hospital)

No conflicts relevant to this study

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Learning Objectives

At the end of this talk, participants will be able to:

- Recognize the existence of *cleaning gaps* and *Grey Zones (GZ)* in their institutions
- Develop an approach to assess the relative risk (in terms of transmission) posed by Grey Zones
- Integrate transmission patterns and hospital design to inform environmental cleaning strategy

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Cleaning of the hospital environment

Routine cleaning is important to ensure a clean and dust-free hospital environment. There are usually many micro-organisms present in "visible dirt", and routine cleaning helps to eliminate this dirt. Administrative and office areas with no patient contact require normal domestic cleaning. Most patient care areas should be cleaned by wet mopping. Dry sweeping is not recommended. The use of a neutral detergent solution improves the quality of cleaning. Hot water (80°C) is a useful and effective environmental cleaner. Bacteriological testing of the environment is not recommended unless seeking a potential source of an outbreak.

Any areas visibly contaminated with blood or body fluids should be cleaned immediately with detergent and water.

Isolation rooms and other areas that have patients with known transmissible infectious diseases should be cleaned with a detergent/ disinfectant solution at least daily.

All horizontal surfaces and all toilet areas should be cleaned daily.

"Practical guidance for infection control in healthcare facilities" WHO guidelines

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The hospital environment

Hospital surfaces frequently contaminated with microorganisms (shed from patients), which can survive on inanimate surfaces for long durations

Transfer of microorganisms to patients generally occurs through hand contact,
Surfaces generally not directly associated with transmission

Organism	Length of Survival on Surfaces
Staphylococcus aureus	7 days – >1 year
Clostridium difficile	5 months
Klebsiella spp.	<1 hour – 30 months
E. coli	<1 hour – 16 months
Acinetobacter spp.	3 days - 5 months
Adenovirus	7 days – 3 months
Norovirus	8 hours – 14 days
Pseudomonas aeruginosa	6 hours – 16 months
VRE	5 days – 4 months

Kramer A, et al BMC Infectious Diseases. 2006;6(1):130.
Weinstein RA, Hota B. : CID 2004;39(8):1182-9.

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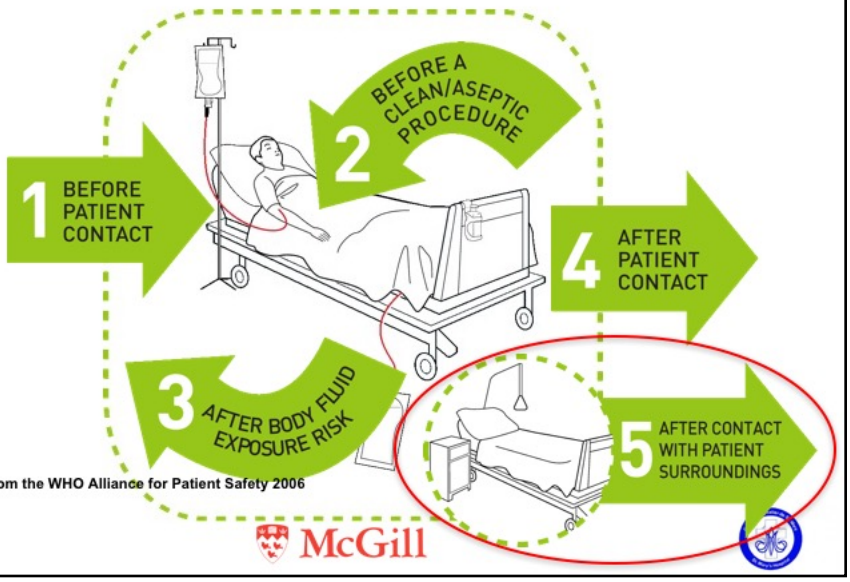
Your 5 moments for hand hygiene at the point of care*



*Adapted from the WHO Alliance for Patient Safety 2006

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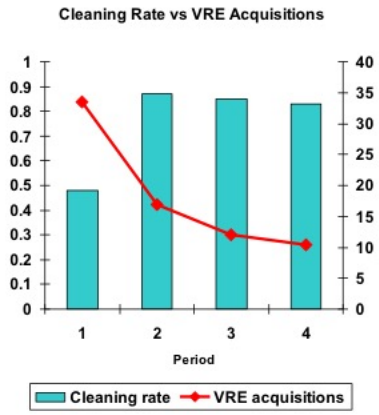
Effect of cleaning on reducing HAI

Difficult to assess role of environmental cleaning experimentally because of many confounders

Some studies have shown no benefit for "extra measures" in terms of reducing MRSA acquisition

Very few comparative studies directly assessing the impact of cleaning strategies on colonization or infection rates



Hayden MK et al. CID 2006;42:1552

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Best practices for environmental cleaning

- Physical removal of dust and organic debris by mopping/rubbing/scrubbing
- Disinfecting (with hospital grade disinfectant)
- Double or "terminal" cleaning of rooms with sporicidal agent for selected rooms (eg. Rooms occupied by *VRE*, *C. difficile* patients)

Normally by trained housekeeping staff

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But in real life..

- Most hospitals apply their own standards for cleaning
- Between hospitals and within institutions, there is variability in terms of
  - Available Resources
  - Frequency of cleaning
  - Monitoring of quality of cleaning
  - Nature of surfaces cleaned

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Variability in cleaning high risk objects

TABLE. Rates of Cleaning for 14 Types of High-Risk Objects

Object	Percentage cleaned: Mean ± SD	Percentage cleaned: Range	95% CI
Sink	82 ± 12	57-97	77-88
Toilet seat	76 ± 18	40-98	68-84
Tray table	77 ± 15	53-100	71-84
Bedside table	64 ± 22	23-100	54-73
Toilet handle	60 ± 22	23-89	50-69
Side rail	60 ± 21	25-96	51-69
Call box	50 ± 19	9-90	42-58
Telephone	49 ± 16	18-86	42-56
Chair	48 ± 28	11-100	35-61
Toilet door knobs	28 ± 22	0-82	18-37
Toilet hand hold	28 ± 23	0-90	18-38
Bedpan cleaner	25 ± 18	0-79	17-33
Room door knobs	23 ± 19	2-73	15-31
Bathroom light switch	20 ± 21	0-81	11-30

NOTE. CI, confidence interval.

Carling et al: Identifying opportunities to enhance environmental cleaning in 23 acute care hospitals, ICHE 2008

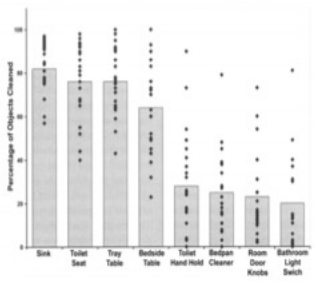

FIGURE 2. Rates of cleaning for the 4 types of object with the highest cleaning rates and the 4 types of object with the lowest rates. *Shaded bar*, mean value; *filled diamond*, value for a single hospital.

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Studies of cleaning/disinfection strategies

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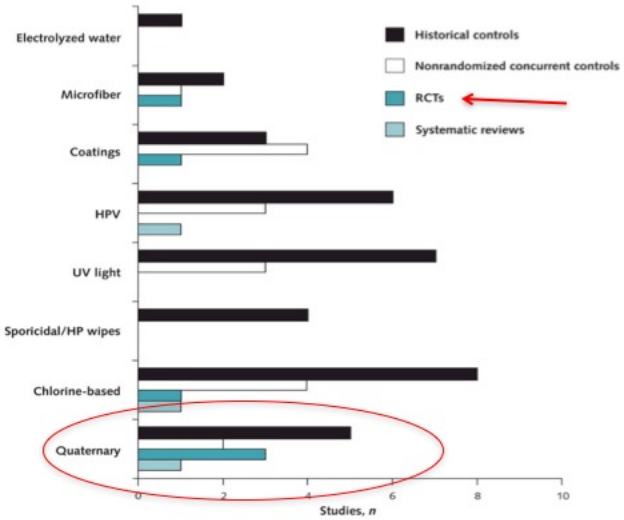

Han *et al*: Cleaning hospital surfaces to prevent healthcare associated infections, Ann Intern Med. 2015;163(8):598-607

Studies assessing monitoring

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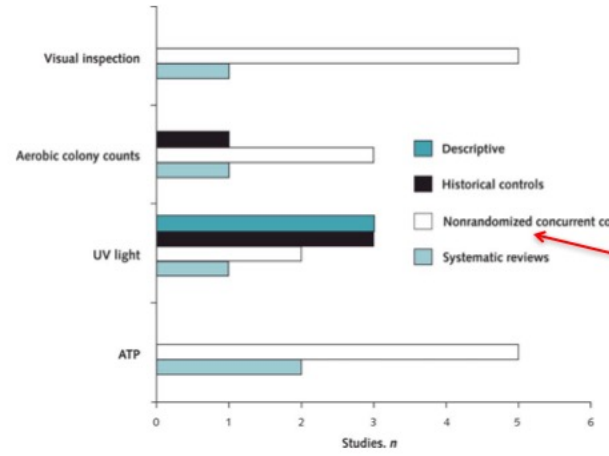

Han *et al*: Cleaning hospital surfaces to prevent healthcare associated infections, Ann Intern Med. 2015;163(8):598-607

No RCTs

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Categories of environmental surfaces

- Spaulding classification:
  - Critical, Semi critical, and Non critical
- Environmental surfaces further divided into:
  - Housekeeping surfaces (eg: floors, walls, table tops, bedrails, ..)
    - *Low touch vs High touch*
  - Medical equipment surfaces (eg: knobs on machines, instrument carts, IV poles,..)

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Potentially contaminated surfaces

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Contaminated medical equipment

Can come into contact with the patient and serve as a direct source of transmission

Or

Source for contamination of healthcare worker's hands or gloves

- Most are "non critical" items
- Often, (can)not cleaned by housekeeping..

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Definition of Grey zones

- *Oxford dictionary: Noun "an intermediate area between 2 opposing positions (..) not clearly or easily defined, or not covered by an existing category or set of rules"*

- Surfaces that are not routinely cleaned, often *because* their cleaning has not been clearly assigned to a category of health care worker (and is left to individual users)
- Often these are equipment and clinical materials used by many service providers
- Specific items vary from institution to institution
  - some are high touch (eg mobile BP equipment)
  - others are rarely in direct contact with patients (eg. Computer keyboards)

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Hypothesis and study objective

- Grey Zones, particularly those that are high-touch, are potentially significant reservoirs of infection
- The impact of cleaning the Grey Zones on transmission of hospital-acquired infections should be measurable
- Study provides an opportunity to assess the role of environmental cleaning on patient outcomes

(Cannot assess impact of NOT cleaning environment!)

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Our setting

- Acute care hospital, 280 beds
- Hand hygiene compliance rate 58-65% (based on 3 audits performed over preceding 4 years)
- VRE incidence: 3.5/1,000 patient-days
- MRSA incidence: 1.8/1,000 patient-days
- *C. difficile* incidence: 0.8/1,000 patient-days

Majority of transmissions: on medical wards A&B

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Study setting

Ward A

- Nurse/patient ratio 1:5 – 1:8
- Capacity 49 beds;
  50% for active medical care
- Built in 1940
- 5 single rooms with private bathrooms; 2,3, 4-bedded rooms with shared bathrooms

Ward B

- Nurse/patient ratio 1:5 – 1:6
- Capacity 34 beds;
  100% active medical care
- Built in 1970
- 4 single rooms with private bathrooms; 15 2-bedded rooms with shared bathrooms

Same floorings, wall coverings, furniture
Same housekeeping staff and cleaning policy

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Screening and surveillance

- Screening for MRSA and VRE at admission for higher risk patients
  - Previous admission (last 12 months) or employment in a healthcare institution
  - Previous positive (at any time) or close contact with positive case
- Weekly ward surveillance screens
- Discharge screening on all patients
- No screening for *C. difficile* carriage, but testing of all diarrhea cases for presence of *C. difficile*

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Infection control policy

- All patients identified as positive for MRSA, VRE or *C. difficile* are placed under isolation, or kept in cohorts with others harboring the same organism – with contact precautions
- Hand hygiene measures – antiseptic hand rubs beside each room, and hand washing sink in each hallway of wards

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Environmental cleaning on wards

- Daily mopping of hospital surfaces (floors in hallways and in patient rooms), daily cleaning of bathrooms with disinfectant, and thorough cleaning/disinfection of rooms after patient discharge
- "Double cleaning" (bleach-based product) of rooms occupied by VRE and *C. difficile* patients after their discharge

But several patient care items not assigned to housekeeping (so not consistently cleaned)

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GZ items routinely found on wards

Grey zone item
Laundry hampers in rooms
Mobile sphygmomanometer
Portable blood pressure
Rolling walker
Manual scale
Patient lift
Foot stool
Leads for cardiac monitor
Shower chair
Suction gauge
Oxygen tanks
Roll board
Clean linen cart in hallway
Clean linen bins in hallway
Cart for patient charts
Utility cart
Laundry cart
Printer for cardiac monitor
Code red monitor

INTERVENTION

- Assign a trained housekeeper for specific cleaning of these items
- Establish cleaning frequency
- Monitor the efficacy of cleaning
- Measure outcomes (transmission rates) to enable cost effectiveness analysis

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High-use/high-touch items

Table 1
Items listed as grey zones on each ward, and cleaning frequency

Grey zone item	Frequency of cleaning	Grey zone item in use on ward(s)
Laundry hampers in rooms	Daily (between patients)	A, B
Mobile sphygmomanometer	Daily (between patients)	A, B
Portable blood pressure	Daily (between patients)	A, B
Rolling walker	Daily (between patients)	A, B
Manual scale	Daily (between patients)	A, B
Patient lift	Daily (between patients)	A, B
Foot stool	Daily (between patients)	A, B
Leads for cardiac monitor	Daily (between patients)	B
Shower chair	Daily (between patients)	A, B
Suction gauge	Daily (between patients)	A, B
Oxygen tanks	Daily (between patients)	A
Roll board	Daily (between patients)	A
Clean linen cart in hallway	Weekly	A, B
Clean linen bins in hallway	Weekly	A, B
Cart for patient charts	Weekly	B
Utility cart	Weekly	B
Laundry cart	Weekly	B
Printer for cardiac monitor	Weekly	B
Code red monitor	Weekly	A

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Cleaning method for GZ

- Wipe with wet rag (soaked in solution containing soap and water) to remove organic debris
- Disinfect using quaternary ammonium-based product (spray or apply with cloth and leave for 10')
- Dedicated trained GZ cleaner weekdays 8-4PM

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The GZ cleaning intervention

Cross over design

	Period 1 (182 days) (Sept 2013 – March 2014)	Period 2 (182 days) (April 2014 – Oct 2014)
Ward A	Routine + **GZ cleaning**	Routine (control)
Ward B	Routine (control)	Routine + **GZ cleaning**

Monitoring:
- Spot visual checks (daily, by head nurse)
- Microbiological testing for growth of MRSA and VRE from random sampling of 15 GZ surfaces (after cleaning)(weekly, by infection control nurses)

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Monitoring of GZ cleaning

- Total 1556 swabs covering 108 surfaces (different items) tested for growth of VRE and MRSA after cleaning (to monitor quality of cleaning)

➢ One swab positive for growth of VRE (electronic patient scale on Ward A); 2 swabs positive for growth of MRSA (walker and IV pole on Ward B)

✓ GZ surfaces adequately cleaned, low microbial burden

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Differences in patient populations

- Between Intervention (routine + GZ cleaning) and Control (routine cleaning only) periods for each ward: no significant differences
  - Similar ages, sex distribution, comorbidity scores, length of stay
- Between Wards A and B:
  - Ward A had on average older patients, longer lengths of stay and greater number of roommates per patient

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Differences in transmission rates

Table 3
Infection incidence rates (per 1,000 patient-days) by period and by ward (N = 2,251)

		Control		Intervention		Poisson regression model			
						Univariate		Multivariable*	
Ward	Pathogen transmission	n	IR†	n	IR†	IRR‡ (95% confidence interval)	*P* value	IRR‡ (95% confidence interval)	*P* value
A	Methicillin-resistant *Staphylococcus aureus*	10	1.45	8	1.11	0.76 (1.96-0.30)	.577	0.76 (2.00-0.29)	.584
	Vancomycin-resistant *Enterococcus*	20	2.9	19	2.65	0.91 (1.69-0.48)	.772	0.91 (1.67-0.50)	.765
	Clostridium difficile	6	0.87	5	0.7	0.80 (2.63-0.24)	.712	0.71 (2.38-0.22)	.582
	Any of 3	34	4.94	31	4.32	0.87 (1.43-0.54)	.589	0.87 (1.39-0.54)	.554
	Total of 3	36	5.23	32	4.46	0.85 (1.37-0.53)	.512	0.85 (1.37-0.52)	.494
B	Methicillin-resistant *S aureus*	11	2.05	12	2.26	1.10 (2.5-0.48)	.817	1.2 (2.56-0.56)	.630
	Vancomycin-resistant *Enterococcus*	33	6.16	17	3.2	**0.52 (0.93-0.29)**	**.029**	**0.54 (0.94-0.31)**	**.029**
	C difficile	10	1.87	5	0.94	0.50 (1.47-0.17)	.212	0.56 (1.67-0.19)	.303
	Any of 3	46	8.59	34	6.41	0.75 (1.16-0.48)	.196	0.78 (1.18-0.52)	.239
	Total of 3	54	10.08	34	6.41	**0.64 (0.98-0.41)**	**.039**	0.66 (1.01-0.44)	.053

NOTE. Bold values are statistically significant $P < .05$. *IR*, Incidence rate; *IRR*, incidence rate ratio.
*Adjusted by age, sex, Charlson comorbidity index scores, average number of roommates, and the correlation for repeated admissions across same patient.
†Per 1,000 patient-days.
‡Intervention versus control.



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Transmission rates

- Overall, lower transmission rates during the intervention (routine + GZ cleaning) compared with routine cleaning only noted on Ward B
- VRE transmission most significantly impacted
  - Incidence rate dropped from 6.2 to 3.2/1,000 patient-days (**2-fold decrease, p = 0.03**)
- Also decrease in *C. difficile* transmission but not statistically significant (small numbers)
- MRSA transmission rates unchanged



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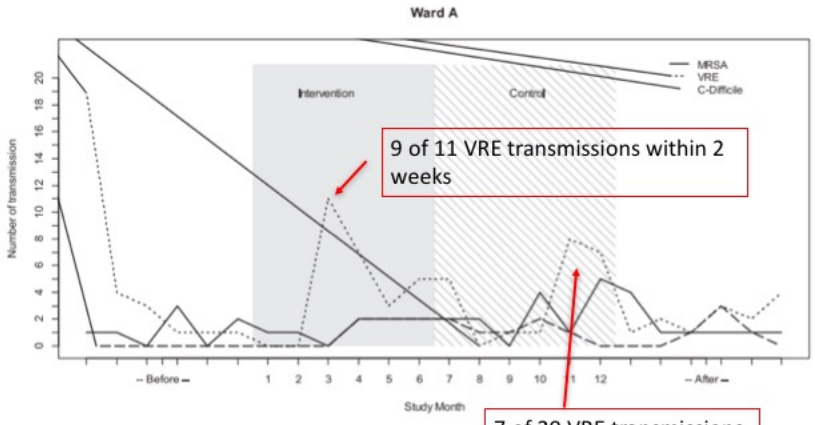
Transmission patterns Ward A



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Transmission patterns Ward B

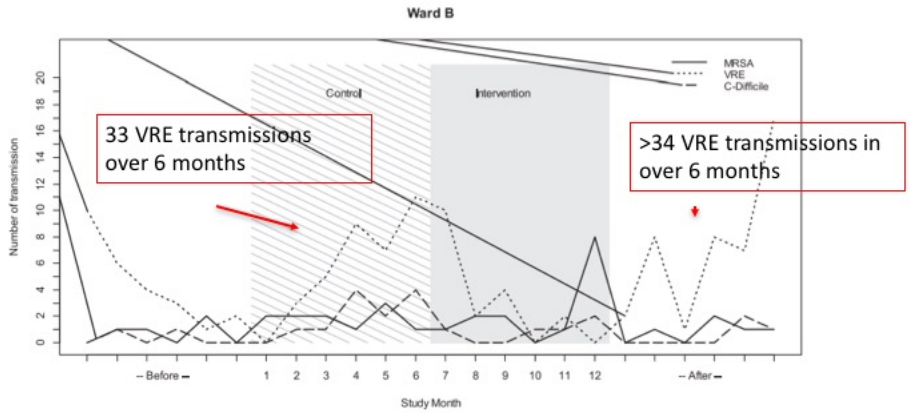

Fig 1. Pattern of transmissions of health care-acquired pathogens over time. MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant *Enterococcus*; C-Difficile, *Clostridium difficile*.

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Transmission patterns

- Ward A: peaks of VRE transmission with majority cases occurring in a short time span (2-3 weeks): consistent with **focal outbreaks**
- Ward B: fairly constant VRE transmissions over long periods of time (months): consistent with **endemic transmission**
- Transmission of MRSA and *C. difficile* low-level and constant throughout the study

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Effect of GZ cleaning

- 2-fold decrease in VRE transmissions on the ward where transmission followed an endemic pattern (patients had fewer roommates and private bathrooms, but "more acute")
  - Actually the ward with highest burden of VRE
- No significant impact on ward where transmissions of VRE is clustered (index patients tend to have more roommates and share bathrooms - but rapidly controlled with cohorting/patient discharges)

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Impact on MRSA transmission rates?

- No impact on MRSA seen in our study
  - Low baseline rates in our institution (decreasing elsewhere in Canada too)
  - Effect of standard cleaning and hand hygiene?
- Study conducted in 2 ICUs in the UK (Wilson *et al*, Crit care med 2011):
  - Reduction in recovery of MRSA from near patient surfaces BUT
  - No impact on patient acquisition of MRSA

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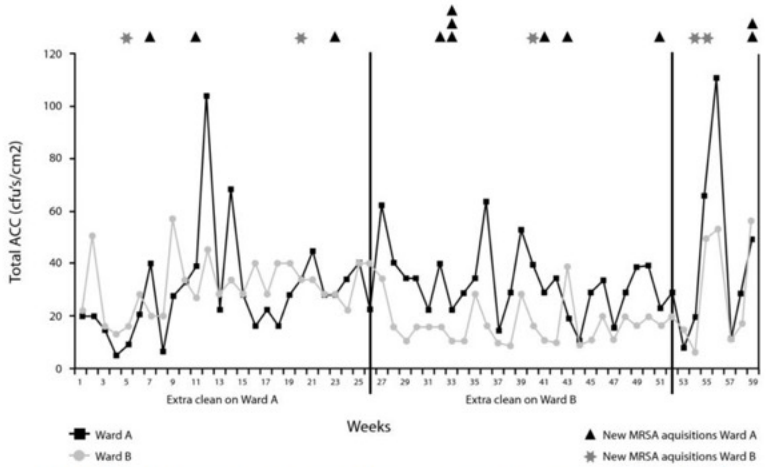
Effect of enhanced cleaning on MRSA transmission (Dancer et al, 2009)



Additional cleaner led to reduction in microbial contamination of high-touch sites, and suggestion of reduction in HCAI MRSA (Dancer et al, BMC 2009)

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Impact of GZ cleaning intervention

- When infrastructure is favorable and IPC program is functional (with screening, surveillance, isolation/cohorting etc) in place: shared patient care items (grey zones) are potential discrete reservoirs of infection
- Targeting GZ items cleaning can be cost-effective
  - VRE increases cost of hospitalization by 17,949$ /patient in Canada (Lloyd-smith P et al, J Hosp Infect 2013)
  - Average salary for housekeeper: 35,000$

  Cost effective if 1 housekeeper prevents 2 VRE acquisitions

  Reduction from 60 to 30 VRE transmissions/year would lead to savings of 500,000$


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Take home messages

- Environmental cleaning is critical for reducing healthcare associated infections.
- Few comparative studies have directly assessed the impact of different cleaning/disinfection strategies on actual patient outcomes
- Endemic (rather than clustered) transmission of healthcare pathogens, in institutions with multicomponent infection prevention strategies in place should prompt consideration of targeted extra-cleaning of clinical care items that are "non-critical" but high-touch
- Cross-over study design an alternative to randomized controlled trials to demonstrate impact and cost-benefit analysis


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Some references

- Semret M, Dyachenko A, *et al*: cleaning the grey zones of hospitals: a prospective cross-over interventional study – Am Jour of Infection Control 44 (2016) 1582-8
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- Han J, Sullivan N, *et al*: cleaning hospital room surfaces to prevent Health-care associated infections – Ann Intern Med 2015 oct 20: 163(8): 598-607
- Carling PC, Parry M, *et al*: Improving cleaning of the environment surrounding patients in 36 acute care hospitals, - ICHE 2008 vol 29(11): 1035-41
- Dancer S, Whyte L, *et al*: Measuring the effect of enhanced cleaning in a UK hospital: a prospective cross over study – BMC Med 2009 Jun 7:28

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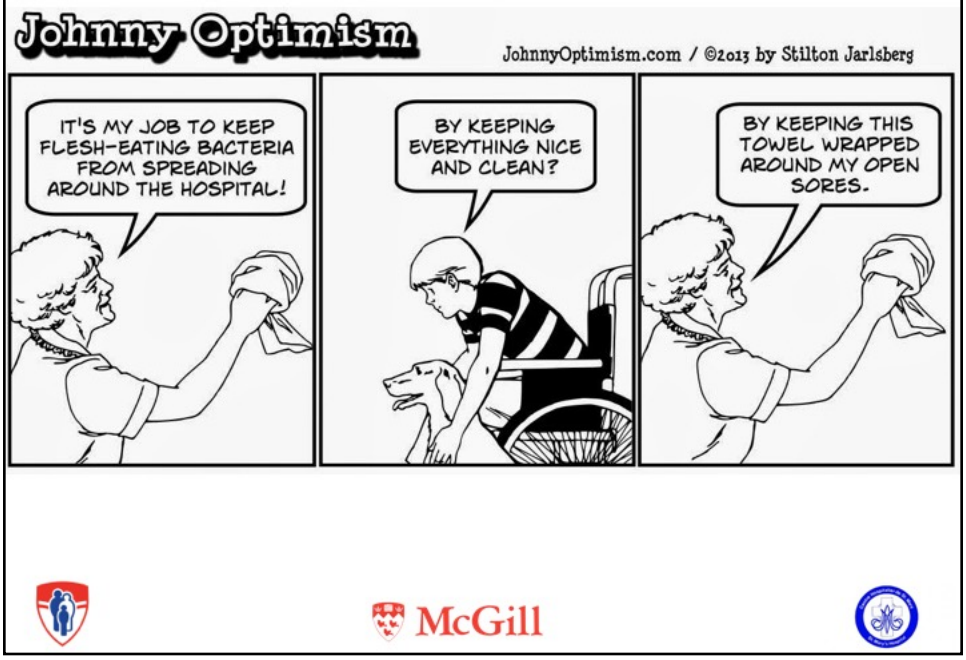

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