

Risk of prior room occupancy for pathogen (MRO) acquisition

IPC Tour 2022

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Disclaimer/background

- Received no fees or payment for this talk
- Do not receive fees or payment from any associated with meeting

Background

- Strength of evidence for environmental cleaning and HAI reduction
- Risk of prior room occupancy as a marker for the importance of cleaning

Background

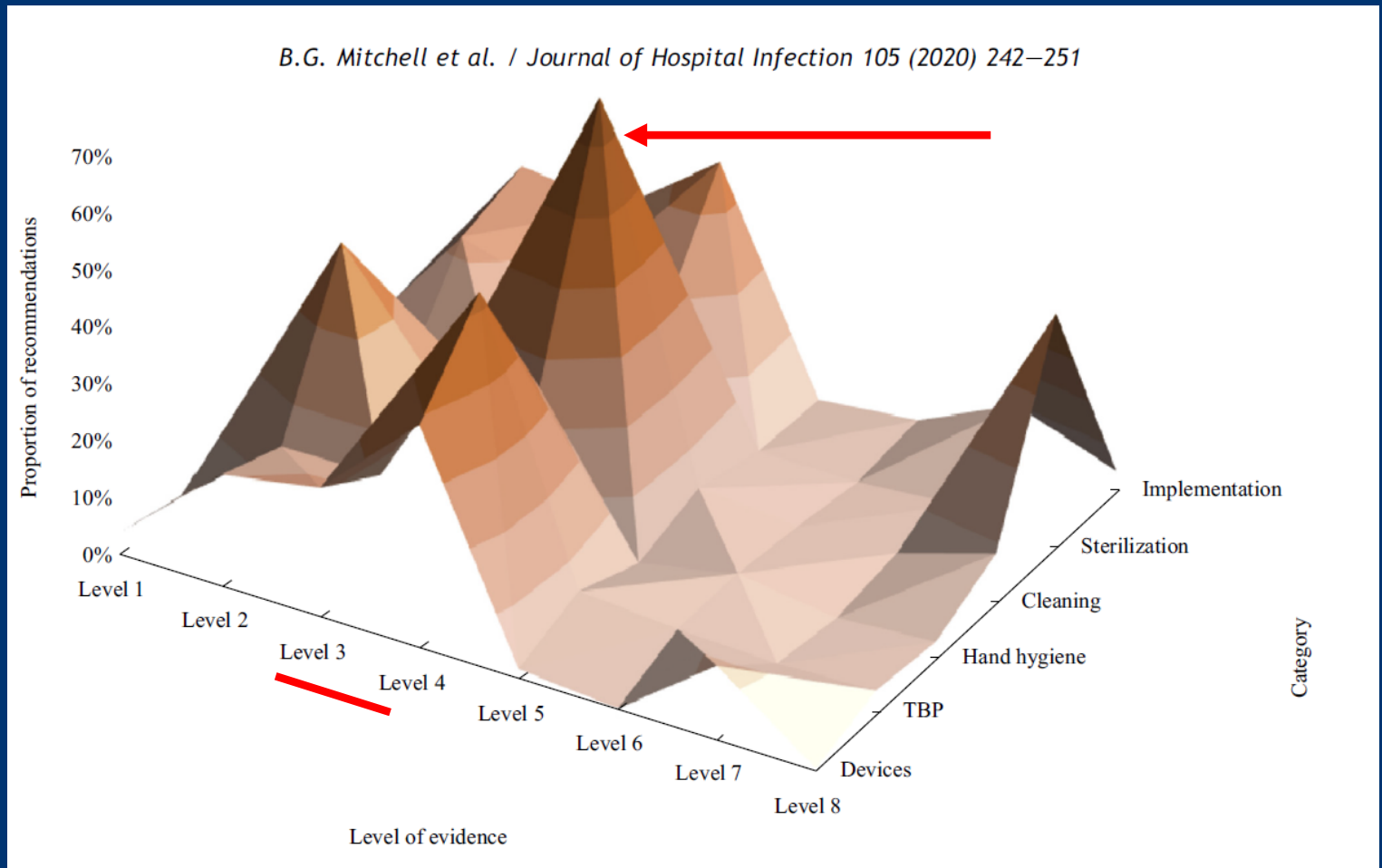


- Only 5 studies RCTs
- Surface contamination was the most commonly assessed outcome.
- Lack of comparative effectiveness studies of disinfecting methods and monitoring strategies
- Future research should evaluate and compare newly emerging strategies, and assess patient-centered outcomes, such as infection, when possible.

Evidence hierarchy



Strength of evidence in current guidelines



Strength of evidence – anything new?



- Most examined colonisation or bioburden
- Interventions - mechanical (n = 8), chemical (n = 7), human factors (n = 3), and bundled (n = 8).

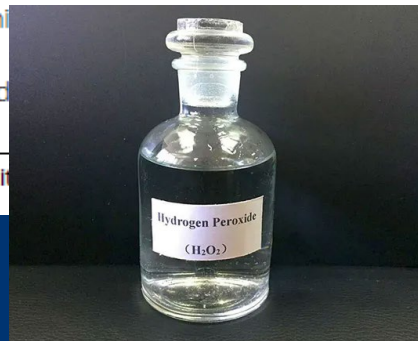


Peters et al (2022)

Table 3 Healthcare environmental hygiene interventions according to the individual type of intervention; systematic review

Interventions	Number	Type
UVC ^a [23, 24, 27, 29, 30, 48]	6	Mechanical
Training, monitoring, feedback [38–40]	3	Human factors
Gaseous hydrogen peroxide [31, 35, 36]	3	Chemical
Liquid hydrogen peroxide [32, 33]	2	Chemical
Negative pressure ventilation system [28]	1	Mechanical
Isolators and air curtains [25]	-	Mechanical
HEPA ^a filters [26]	-	Mechanical
TiO ₂ antimicrobial surface coating [34]	-	Mechanical
Copper antimicrobial surface coating [37]	-	Mechanical
Training and education and color-coded wipes [42]	-	Bundle: human factors, mechanical
Training and education, monitoring and feedback and workflow	-	Bundle: human factors, mechanical
External cleaning with microfiber, ultraviolet light, water filter	-	Bundle: chemical, mechanical
cleaning [43]	-	
Hypochlorite with training [44]	-	Bundle: chemical, mechanical
Gaseous hydrogen peroxide, disposable bleach, cleaning solution, training and	1	Bundle: chemical, mechanical
education, monitoring and feedback, color-coded surveillance, and workplace	-	
reminders [45]	-	
Gaseous hydrogen peroxide, liquid hydrogen peroxide, monitoring	-	Chemical
feedback [46]	-	
Training and education, monitoring and feedback, enhanced	-	Human factors, chemical (minor), mechanical (minor)
practices, disposable wipes [47]	-	

^a UVC ultraviolet-C light, HEPA high efficiency particulate air, TiO₂ titanium dioxide



Peters et al (2022)

- Of the 26 articles, 3 “Grade A” quality

Table 4 Quality scoring of included studies; systematic review; N = 26

Study title	Study design	Sample size	Control	Adjusted for confounding factors	Conflict of Interest and reporting	Final grade
Prospective cluster controlled crossover trial to compare the impact of an improved hydrogen peroxide disinfectant and a quaternary ammonium-based disinfectant on surface contamination and health care outcomes [32]	4	2	4	4	3	A
Enhanced terminal room disinfection and acquisition and infection caused by multidrug-resistant organisms and <i>Clostridium difficile</i> (the Benefits of Enhanced Terminal Room Disinfection study): a cluster-randomised, multicentre, crossover study [48]	4	4	4	4	3	A
An environmental cleaning bundle and health-care-associated infections in hospitals (REACH): a multicentre, randomised trial [47]	4	4	4	4	3	A

Peters et al (2022)

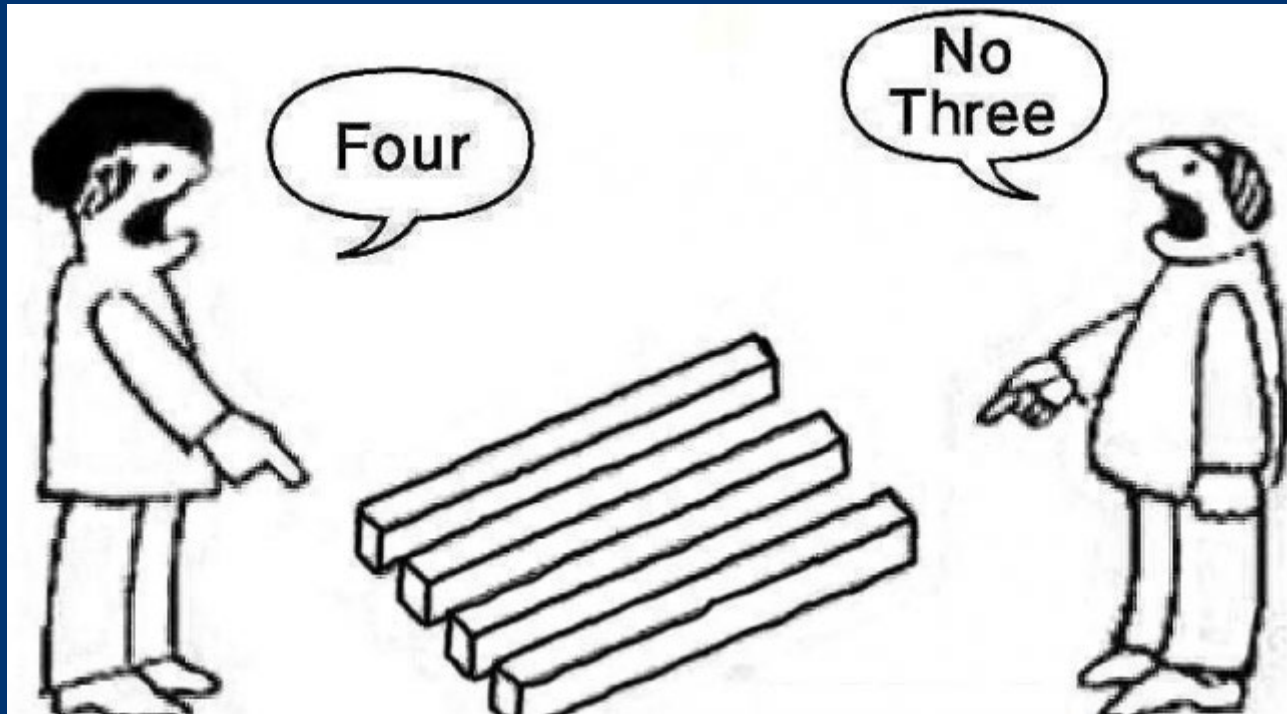
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Author		
Wilcox et al (2003)	<i>C.difficile</i>	Hypochlorite
Anderson et al (2017)	VRE	UV
	VRE	Bleach
	VRE	UV + Bleach
Boyce et al (2017)	VRE	Liquid hydrogen peroxide
Mitchell et al (2019)	VRE	Bundle

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Other ways to look at the role of the environment on pathogen transmission



Survival of pathogens

Table 1: Persistence of clinically relevant bacteria on dry inanimate surfaces.

Type of bacterium	Duration of persistence (range)	Reference(s)
Acinetobacter spp.	3 days to 5 months	[18, 25, 28, 29, 87, 88]
Bordetella pertussis	3 – 5 days	[89, 90]
Campylobacter jejuni	up to 6 days	[91]
Clostridium difficile (spores)	5 months	[92–94]
Chlamydia pneumoniae, C. trachomatis	≤ 30 hours	[14, 95]
Chlamydia psittaci	15 days	[90]
Corynebacterium diphtheriae	7 days – 6 months	[90, 96]
Corynebacterium pseudotuberculosis	1–8 days	[21]
Escherichia coli	1.5 hours – 16 months	[12, 16, 17, 22, 28, 52, 90, 97–99]
Enterococcus spp. including VRE and VSE	5 days – 4 months	[9, 26, 28, 100, 101]
Haemophilus influenzae	12 days	[90]
Helicobacter pylori	≤ 90 minutes	[23]
Klebsiella spp.	2 hours to > 30 months	[12, 16, 28, 52, 90]
Listeria spp.	1 day – months	[15, 90, 102]
Mycobacterium bovis	> 2 months	[13, 90]
Mycobacterium tuberculosis	1 day – 4 months	[30, 90]
Neisseria gonorrhoeae	1 – 3 days	[24, 27, 90]
Proteus vulgaris	1 – 2 days	[90]
Pseudomonas aeruginosa	6 hours – 16 months; on dry floor: 5 weeks	[12, 16, 28, 52, 99, 103, 104]
Salmonella typhi	6 hours – 4 weeks	[90]
Salmonella typhimurium	10 days – 4.2 years	[15, 90, 105]
Salmonella spp.	1 day	[52]
Serratia marcescens	3 days – 2 months; on dry floor: 5 weeks	[12, 90]
Shigella spp.	2 days – 5 months	[90, 106, 107]
Staphylococcus aureus, including MRSA	7 days – 7 months	[9, 10, 16, 52, 99, 108]
Streptococcus pneumoniae	1 – 20 days	[90]
Streptococcus pyogenes	3 days – 6.5 months	[90]
Vibrio cholerae	1 – 7 days	[90, 109]

- Acinetobacter spp
 - 3d- 5m
- C.difficile
 - 5m
- E.Coli
 - 1.5hrs-16m
- Enterococcus spp.
 - 5d-4m
- S.aureus
 - 7d-7m

Systematic review – risk of prior room occupancy



Acquires the
same pathogen



Would you want to be admitted to room where the prior occupant had a MRO?

Infection, Disease & Health (2021) 26, 55–62



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Research paper

Nurses' and midwives' cleaning knowledge, attitudes and practices: An Australian study

Brett G. Mitchell ^{a,b,*}, Philip L. Russo ^{c,d}, Martin Kiernan ^{a,e}, Cassie Curryer ^a

Systematic review



In patients admitted to hospital, what is the risk of infectious organism acquisition for patients admitted to a hospital room where the prior occupant was colonised with an infectious organism, compared to a room where the prior occupant did not have an infectious organism?

Systematic review

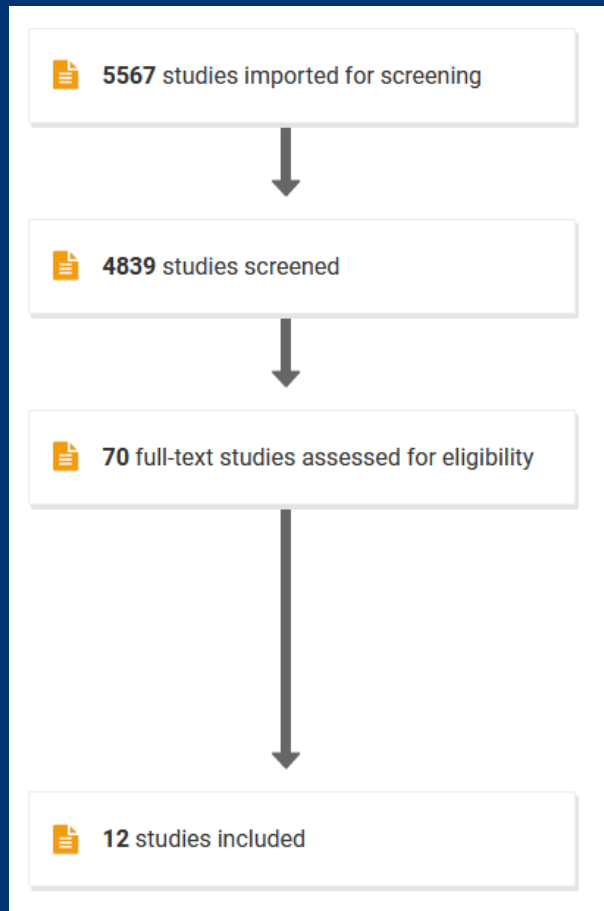
- Studies which have examined hospitalised patients occupying a room where the previous occupant was colonised with a specific organism
- Reported data on acquisition prevalence and or incidence rates in hospitalised patients
- Peer reviewed studies published between January 1st 2005 and December 31st 2021

Systematic review – included new pathogens

- Vancomycin resistant enterococcus, Acinetobacter species, Escherichia coli, Klebsiella, Pseudomonas species, Enterobacter species, Proteus species, Serratia species, Enterococcus species, *Clostridioides difficile*, *Staphylococcus aureus*, Methicillin resistant *Staphylococcus aureus*, Citrobacter species, paramyxoviruses, respiratory syncytial virus, parainfluenza, Rhinoviruses, Adenoviruses, Orthomyxoviruses, influenza, Norovirus, Norwalk-like viruses, and Rotavirus.

Systematic review

- Study published in 2015, 7 articles found
- Found 12 articles

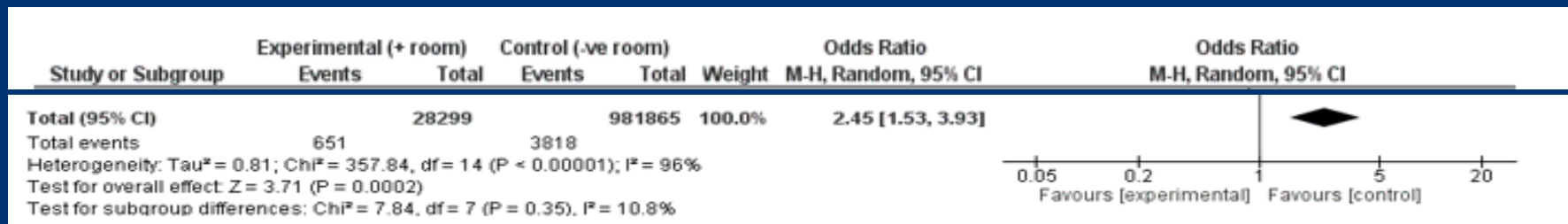


Results to follow - disclaimer

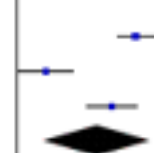
- New
- Not yet peer-reviewed
- ROB assessments
- Subject to change

Systematic review – all pathogens

Experimental (+ve)		Control (-ve)		Odds ratio
Events	Total	Events	Total	
651	28299	3818	981865	2.45
				95%CI 1.53-3.93)



Systematic review – MRSA

Study or Subgroup	Experimental (+ room)		Control (-ve room)		Weight	Odds Ratio	Odds Ratio
	Events	Total	Events	Total		M-H, Random, 95% CI	M-H, Random, 95% CI
1.1.1 MRSA							
Anderson	103	11005	725	293386	7.1%	3.81 [3.10, 4.69]	
Huang	57	1454	248	8697	7.0%	1.39 [1.04, 1.86]	
Mitchell	74	884	163	5344	7.0%	2.90 [2.18, 3.86]	
Subtotal (95% CI)		13343		307427	21.1%	2.50 [1.38, 4.54]	
Total events	234		1136				
Heterogeneity: Tau ² = 0.26; Chi ² = 31.61, df = 2 (P < 0.00001); I ² = 94%							
Test for overall effect: Z = 3.01 (P = 0.003)							

3 studies

Odds ratio 2.5 (1.38-4.54)

Systematic review – *C.difficile*

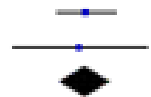
1.1.5 *Clostridioides difficile*

Anderson	43	3797	1278	307890	7.0%	2.75 [2.02, 3.73]
Shaughnessy	10	91	77	1679	6.2%	2.57 [1.28, 5.15]
Subtotal (95% CI)		3888		309569	13.2%	2.72 [2.05, 3.60]

Total events 53 1355

Heterogeneity: $\tau^2 = 0.00$; $\text{Chi}^2 = 0.03$, $df = 1$ ($P = 0.86$); $I^2 = 0\%$

Test for overall effect: $Z = 7.01$ ($P < 0.00001$)



2 studies

Odds ratio 2.72 (2.05-3.60)

Systematic review – Norovirus

NEW

1.1.8 Norovirus

Fraenkel	5	1016	49	32772	5.7%	3.30 [1.31, 8.31]
Subtotal (95% CI)		1016		32772	5.7%	3.30 [1.31, 8.31]
Total events	5		49			
Heterogeneity: Not applicable						
Test for overall effect: $Z = 2.54$ ($P = 0.01$)						



1 study

Odds ratio 3.30 (1.31-8.31)

Systematic review – VRE

1.1.2 VRE

Anderson	89	4083	423	307241	7.1%	16.16 [12.83, 20.36]
Drees	19	138	31	500	6.4%	2.42 [1.32, 4.43]
Ford	47	149	89	300	6.8%	1.09 [0.71, 1.67]
Huang	58	1291	256	9058	7.0%	1.62 [1.21, 2.16]
Zhou	69	3556	92	4929	7.0%	1.04 [0.76, 1.43]
Subtotal (95% CI)		9217		322028	34.3%	2.36 [0.61, 9.15]

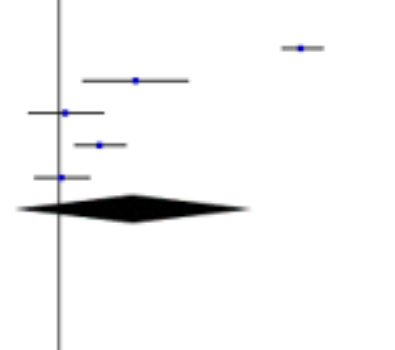
Total events

282

891

Heterogeneity: $\tau^2 = 2.35$; $\chi^2 = 329.40$, $df = 4$ ($P < 0.00001$); $I^2 = 99\%$

Test for overall effect: $Z = 1.24$ ($P = 0.22$)



VRE

- Highest quality evidence from RCTs suggests cleaning plays a role in breaking VRE transmission
- Prior room occupancy data are not as conclusive

Half the story

- Focus on environmental cleaning services in studies..but....





Research paper

Nurses' and midwives' cleaning knowledge, attitudes and practices: An Australian study

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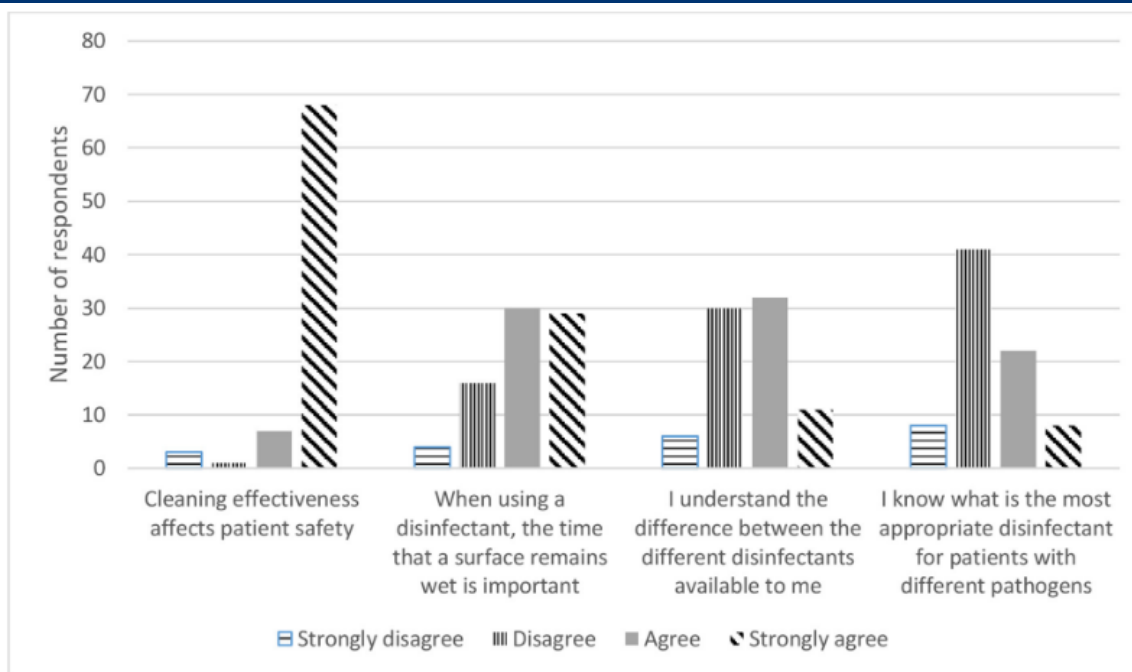


Fig. 1 Level of agreement to cleaning and disinfectant knowledge.

So what is all this telling us

- Increasing number of high-quality studies showing the value of cleaning
- Strong epidemiological evidence via prior room occupancy of risk
 - Depending on your own systems, might be able to explore this locally
- Need to think about other aspects of cleaning and impact and neither of the above deal with this

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