

Nurses' and Midwives' Cleaning Knowledge, Attitudes and Practices: An Australian Study.

Abstract

Background

As frontline providers of care, nurses and midwives play a critical role in controlling infections such as COVID-19, influenza, multi-drug resistant organisms and health care associated infections. Improved cleaning can reduce the incidence of infection and is cost effective but relies on healthcare personnel to correctly apply cleaning measures. As nurses and midwives have the most contact with patients and as an important first step in improving compliance, this study sought to explore nurses' and midwives' knowledge on the role of the environment in infection prevention and control and identify challenges in maintaining clean patient environments.

Methods

Cross-sectional online survey of 96 nurses (RN/EN) and midwives (RW) employed in clinical settings (e.g. hospital, aged care, medical centre, clinic) in Australia.

Results

Nurses and midwives broadly stated that they understood the importance of cleaning. However, cleaning responsibilities varied and there was confusion regarding the application of different disinfectants when cleaning after patients with a suspected or diagnosed infection post-discharge. Most would not be confident being placed in a room where a previous patient had a diagnosed infection such as multi-drug resistant organism.

Conclusion

Greater organisational support and improving applied knowledge about infection control procedures is needed. This includes correct use of disinfectants, which disinfectant to use for various situations, and cleaning effectively following discharge of a patient with known infection. The cleanliness of shared medical equipment may also pose current risk due to lack of cleaning.

Introduction

As frontline providers of care, nurses and midwives play a vital role in prevention and control of infections such as COVID19, influenza, multi-drug resistant organisms (MDROs) and health care associated infections (HCAIs) more broadly. However, nurses' and midwives' compliance with infection control policies can vary between settings and individual workers (1-3). Subjective indicators such as visible dirt, personal appearance and whether a patient had been identified as being infectious, can inform nurses' decision-making regarding even basic standard precautions such as handwashing (1, 3-6). This reliance on personal judgement rather than consistent application of clinical standards for infection prevention and control could potentially lead to cross-contamination and subsequently, increase rates of infection. Experience, organisational structure (including staffing ratios and training), individual knowledge, and personal accountability may also impact on compliance with optimal infection control practice and governance (7-11).

Beyond individual factors, the hospital environment has been shown to be a contributing factor in the spread of HCAIs and MDROs (12, 13). Moreover, pathogens can survive for days or months on surfaces that have not been cleaned, posing an ongoing risk for transmission (14). Consequently, there is a higher risk of a patient acquiring a pathogen from the previous room occupant (15, 16). Improved cleaning can reduce the incidence of HCAIs and is cost effective (12, 17), but relies on healthcare personnel to correctly and consistently apply cleaning measures. Nurses and midwives have the most contact with patients across healthcare settings. Therefore, they have a critical role in infection prevention and control. As an important first step in improving compliance and precursor to further work, this study sought to explore:

1. What are enrolled nurses, registered nurses and midwives' knowledge on the role of the environment in the infection prevention control, and
2. What are the barriers and challenges for nurses and midwives to maintaining a clean patient environment?

Methods

Study design

This paper reports findings from a cross-sectional, online survey of nurses and midwives employed in clinical roles.

Setting

Registered nurses (RN), enrolled nurses (EN) and registered midwives (RM) who are currently employed in clinical settings in Australia.

Recruitment

Participants were recruited via advertisements placed in written and electronic materials published by professional associations (such as the Australian College of Nursing and the Australian Nurses and Midwives Association), via workplace emails and newsletters, and through social media (Facebook, twitter) targeting nurses and midwives. The advertisements provided broad information about the survey, and included an online link to the study information, electronic consent form, and non-identifiable survey. Ten \$20 gift cards were randomly allocated as a participation incentive. Participants who were not registered nurses, midwives or enrolled nurses were excluded from the study, in addition to those currently unemployed or not working in clinical roles (e.g. hospital, residential aged care facility, medical centre, or clinic).

Data collection

The survey was open for responses between 1st December 2019 and 13th March 2020; at which time the survey was closed due to dwindling response rates. Interested participants accessed the online link as provided in the study invitation. Screening questions were used to exclude individuals who did not meet criteria for eligibility. Eligible participants then completed an online consent form before gaining access to the survey. The online survey contained questions (multiple choice, yes/no and open-ended) relating to their perceptions and knowledge about infection control and cleaning. The survey was developed by three infection control experts and piloted informally on a small group of registered nurses to enable refinement of survey questions. Demographic information was collected, including nursing association affiliation, age, gender, years of nursing experience (post qualification) and highest (completed) qualification. No identifiable information was collected. The survey is available as supplementary material.

Data analysis

Descriptive and exploratory analysis of survey results was performed. Qualitative (free-text) responses to open-ended questions were collated and each response read individually. Qualitative analysis (constant comparison, frequency counts/ranking) was used to identify and group responses into common themes.

Results

Overview

132 participants accessed the online survey. Of these, 28 were subsequently excluded from the survey (n= 19 not currently working in a clinical setting; n= 6 not RN, EN or RM; and n=3 did not provide consent). Of the 104 eligible participants, 96 consented to participate and commenced the survey, representing our sample size. 79 participants completed the full survey. The use of IP address cross referenced against demographic information suggested there were no repeat responses from the same individual. Participant demographic data is presented in Table 1. There was representation across all age groups, with diversity in the highest qualification obtained, the length of time at their current employer and the jurisdiction in which they worked. Most participants worked in a hospital setting.

[Table 1]

Cleaning knowledge

Importance of cleaning

Participants were asked to nominate the most important reasons for cleaning the environment in healthcare settings. Seventy-four (94%) participants indicated that the main reason for cleaning was to reduce the risk of infection transmission. Healthcare accreditation was found to be the least important reason for cleaning (n=35, 44%).

Cleaning responsibility

We asked participants to indicate who was responsible for cleaning four items, two frequently touched items (bed rails and nurse call bells) and two items of shared medical equipment (IV pole and IV pump). The majority of participants indicated that nursing/midwifery staff were responsible for cleaning the IV pole (73%, n=58) and pump (79%, n=62). There was less certainty about who was

responsible for cleaning bed rails and nurse call bells. Forty-percent (40%, n=32) indicated it was a nursing/midwifery responsibility. Ten percent of participants did not know who was responsible for cleaning shared medical equipment (IV pole and pump). Participants were asked to nominate what method or product they would use to clean in various situations. Results are presented in Table 2.

[Table 2]

Knowledge and practice

Using a Likert scale, participants were asked to indicate how much they agreed with four statements relating to the use and application of disinfectant products in clinical settings (Figure 1). While the effectiveness on patient safety was well understood, there was less certainty about disinfectants and their use.

[Figure 1]

Participants were shown four visual representations of how to clean a surface, using different directional movements such as circular, up and down, one-directional or S-shaped (serpentine). Of those that answered, 61% (n=48) correctly identified the best way to clean a surface (i.e., answer = C, serpentine). Regarding cleaning of shared medical equipment such as a blood pressure cuff, a small number reported 'probably don't clean' (14%, n=11) this equipment. The majority (81%, n=64) reported using wipes to clean shared medical equipment (supplementary material, Table S1).

Participants were shown pictures of three patient hospital rooms (Figure 2). Room A showed a patient lying present in the bed with various equipment. Room B appeared to be empty, with the bed looking slightly ruffled. Room C showed a patient lying in bed and was less cluttered in appearance than Room A. Participants were then asked to nominate which room presented the lowest risk of infection (A, B, C, or 'don't know'). The majority chose Room A, a cluttered room occupied by a patient.

[Figure 2]

Using a free text option, participants were asked what one item/piece of equipment they thought posed the greatest risk of infection transmission from the environment. The most common

responses were hospital furniture (beds, bedside tables, curtains, call bells, door handles), peoples' hands, and patient observation machines. Other suggestions included clinical staff, nursing stations and items frequently used by nurses. Participants also highlighted the role of nursing and other staff behaviours in either spreading or containing infection. For example, one participant commented: *'boxes of wall mounted gloves. Seen people pull gloves out, too many come out, they fall on the floor, so people pick up [the] gloves and put them back in the box!'*

Barriers and challenges to cleaning effectiveness

The themes from participants around barriers to cleaning effectively were a lack of information and training, resources (cleaning products and equipment), lack of dedicated cleaning staff, and organisational structures. The free-text survey comments (supplementary material, SQ1-2) stressed the need for more readily accessible information including simple wall charts with information about which product to use and where and improved labelling on wipes and cleaning agents. More education was needed about which products were recommended for patients presenting with infections such as *C.difficile* or multi-drug resistant organism (MDRO). Product useability was important, with single-use disinfectant wipes preferred, especially where staff experienced competing time pressures. A lack of policies and guidelines to inform infection control practices and lack of clear role definitions and staff accountability were also identified. In contrast to most comments, seven participants perceived that 'nothing' impacted their ability to clean equipment between patients, i.e., cleaning always occurred even when staff were pressed for time.

Education, personal efficacy and confidence

Most participants reported having received information about cleaning importance, correct product usage and availability. Twenty-three percent (n=18) had received information within last 3 months, 19% (n=15) in the previous 3-12 months and 15% (n=12) reported having received information in the last 1-3 years. However, 32% (n=25) either 'do not recall' or have 'never' received any information about the importance of cleaning, product availability in their organisation, nor how to correctly apply products for infection control purposes. The majority of training received (25%, n=20) was provided by an Infection Control Team (Table S2). Additionally, using a Likert scale, participants were asked to indicate level of agreement with four statements regarding cleaning effectiveness (Table S3). Despite the majority indicating confidence in their cleaning ability (usually 46%, n=36; always

23%, n=18), most did not feel comfortable being admitted to a room where the previous patient had a multi-drug resistant organism (never 42%, n=33; only sometimes 34%, n=18).

Discussion

It is well accepted that the clinical environment plays a role in the transmission of infections such as multi-drug resistant organisms (MDROs) and healthcare associated infections (HCAIs) (2, 7, 8, 12, 14, 15, 17-20). Ineffective cleaning practices by nursing and midwifery staff may also contribute to a high pathogen-load being present within hospital settings (15, 19, 21). As an important first step to improving environmental hygiene, this study found that nurses and midwives broadly stated that they understood the importance of cleaning, albeit, there is variation in cleaning responsibilities. Moreover, cleaning of shared medical equipment may pose current risk in terms of lack of cleaning.

In keeping with Aiken et al (22), this study found that nursing and midwifery staff play a key role in cleaning duties as part of their working role. However, our findings suggest there was ambiguity about who was responsible for cleaning patient areas or certain items (such as IV pumps). There was also less certainty regarding how or when to use disinfectants and about the effectiveness of disinfectants on different groups of micro-organisms. These findings could be a result of any number of factors, including appropriateness of the product, lack of product information or of education. The implications of inappropriate product use may result in ineffective cleaning, thus increasing the risk of HCAIs. There are also health and safety implications for disinfectant use. In terms of the process of cleaning, 39% (n=31) of participants did not identify the correct way to clean (wipe) a surface (i.e. S-shaped or serpentine). Therefore, this finding, coupled with a lack of understanding about product (disinfectant) choice, will result in less effective cleaning and increase transmission risks.

As pathogens can survive on uncleaned or inappropriately cleaned surfaces for long periods of time, it is vital that shared medical equipment is consistently and correctly cleaned to reduce the risk of HCAIs. Genomic analyses by Lee et al (23) of VRE transmission pathways within an intensive care unit identified the key role shared medical equipment has in ICU. Factors for suboptimal cleaning of shared equipment may include insufficient stocks of equipment to allow for cleaning and rotation between patients, lack of product at the point of use and perceived lack of time (1, 7, 19).

Understanding reasons for this are important and we will be following this up in future work. Survey participants called for more easily accessible information about the different types of cleaning

products and what they were used for, greater accessibility to products, greater clarity around cleaning roles and who was responsible for maintaining particular items or patient areas, as well as increased accountability on the behalf of staff and hospital management.

Factors that may influence a decision for cleaning to take a secondary role include the perception of infection risk from the environment versus other competing patient care requirements, as well as understanding cleaning responsibilities. When we asked participants to identify which room posed the highest infection risk, the majority of participants chose the most cluttered room. This indicates good understanding among respondents that cluttered environments can hamper cleaning. However, the correct answer was 'don't know', i.e., while this room may reflect challenges undertaking cleaning, it does not necessarily relate to risk. Pathogens are invisible to the naked eye and any of the rooms may pose an infection risk (15). Factors influencing risk would include the type of infection or pathogen from an unknown but colonised patient, as well as the effectiveness of cleaning. None of the provided images illustrated this. The subjectivity of choosing a room which is cluttered is consistent with other work, which found that compliance with even basic infection protocols such as handwashing and wearing gloves was individually and subjectively based (3-5).

Variations in product use and cleaning practices (21, 24, 25), information transfer and communication pathways (26-28), and organisational culture (20), can all influence cleaning outcomes. Improving staff knowledge around product use, communication, training, audit and utilising an implementation framework have been shown to improve cleaning outcomes, reduce risks for patients and are cost-effective (12, 29, 30). In our study, most participants (68%, n=54) indicated that they had received information about the importance of cleaning, the types of products available in their organisation and product application. However, 11% (n=9) had last received that information more than 3 years prior and a further 32% (n= 25) did not recall or had never received any cleaning information. Another key theme emerging from survey comments was the lack of simple information about particular cleaning products. Participants called for easy instructions to support correct product usage and application. These findings suggest the need for improved and structured education of nurses and midwives around cleaning on a regular basis, as well as improved communication. Education could be provided in any number of ways, including from nurse educators, online platforms or from representatives from industry supplying products and equipment. Of course, nurses are only one professional group in healthcare. Shared medical equipment is also used by medical and allied health. Potentially the same issues exist in these

professional groups regarding knowledge of cleaning and responsibilities around who cleans equipment they use.

This study is limited by the use of a cross-sectional study design and the accuracy of self-report responses provided. The vast majority of surveys were undertaken prior to the COVID-19 pandemic taking hold in Australia, so biases associated with this are expected to be limited. The sample size, while not large is a further limitation. Nonetheless, this study provides a useful snapshot of nurses' and midwives' knowledge of infection control and cleaning processes, something that to our knowledge has not been undertaken before. We identified gaps in training and knowledge, as well as unclear responsibilities for cleaning certain objects. These findings can be used to inform workforce education and planning and hospital cleaning policies. Similarly, the findings lay the foundation for future research exploring solutions to try and improve the cleaning of shared medical equipment.

Conclusion

Greater organisational support, clear policies detailing cleaning responsibility, and improving the applied knowledge and personal efficacy of nurses and midwives regarding infection prevention and control is needed. This includes the correct use of disinfectants, which disinfectant to use for various situations, and how to clean effectively following discharge of a patient with a suspected or known infection. The cleanliness of shared medical equipment may also pose current risk due to lack of cleaning.

Acknowledgements

Thank you to the participants in this survey.

Funding

In kind support is provided by the higher education institutions with which the Chief Investigators are affiliated.

Ethical considerations

Ethics approval for this study was granted by [blinded for review]

Authorship statement

XX, XX and XX designed the project. XX is the Chief Investigator for the project. XX and XX drafted the paper. All authors provided critical input into the paper. All authors approved the manuscript.

Conflict of Interest

Two of the authors (XX and XX) are editorial board members with the journal. All authors were blinded to this submission in the journal's electronic editorial management system and none of the authors played any editorial role in handling this paper whatsoever. One author (XX) has paid employment from a company which sells cleaning products, as well as university appointments. No company played no any role in the design, analysis, interpretation or presentation of this paper.

References

1. Efstathiou G, Papastavrou E, Raftopoulos V, Merkouris A. Factors influencing nurses' compliance with Standard Precautions in order to avoid occupational exposure to microorganisms: A focus group study. *BMC Nursing*. 2011;10(1):1.
2. Koh Y, Hegney DG, Drury V. Comprehensive systematic review of healthcare workers' perceptions of risk and use of coping strategies towards emerging respiratory infectious diseases. *International Journal of Evidence Based Healthcare*. 2011;9(4):403-19.
3. Whitby M, McLaws M-L, Ross MW. Why Healthcare Workers Don't Wash Their Hands: A Behavioral Explanation. *Infection Control & Hospital Epidemiology*. 2006;27(5):484-92.
4. Bouchoucha SL, Moore KA. Infection prevention and control: Who is the judge, you or the guidelines? *Journal of Infection Prevention*. 2017;19(3):131-7.
5. Jackson C, Griffiths P. Dirt and disgust as key drivers in nurses' infection control behaviours: an interpretative, qualitative study. *Journal of Hospital Infection*. 2014;87(2):71-6.
6. Jackson C, Lowton K, Griffiths P. Infection prevention as "a show": A qualitative study of nurses' infection prevention behaviours. *International Journal of Nursing Studies*. 2014;51(3):400-8.
7. Alyahya MS, Hijazi HH, Al Qudah J, AlShyab S, AlKhalidi W. Evaluation of infection prevention and control policies, procedures, and practices: An ethnographic study. *American journal of infection control*. 2018;46(12):1348-55.
8. Mitchell BG, Gardner A, Stone PW, Hall L, Pogorzelska-Maziarz M. Hospital staffing and health care-associated infections: A systematic review of the literature. *The joint commission journal on quality and patient safety*. 2018;44(10):613-22.
9. Mitchell B, McBeth, D., Halton, K., Gardner, A., Hall, L. Resourcing hospital infection prevention and control units in Australia: A discussion paper. . *Infection, Disease & Health*. 2017;In proof.
10. Morrow E, Griffiths P, Rao GG, Flaxman D. "Somebody else's problem?" Staff perceptions of the sources and control of methicillin-resistant *Staphylococcus aureus*. *American journal of infection control*. 2011;39(4):284-91.
11. Halton K, Hall L, Gardner A, MacBeth D, Mitchell BG. Exploring the context for effective clinical governance in infection control. *American journal of infection control*. 2017;45(3):278-83
12. Mitchell BG, Hall L, White N, Barnett AG, Halton K, Paterson DL, et al. An environmental cleaning bundle and health-care-associated infections in hospitals (REACH): a multicentre, randomised trial. *The Lancet Infectious Diseases*. 2019;19(4):410-8.
13. Ledwoch K, Dancer SJ, Otter JA, Kerr K, Roposte D, Rushton L, et al. Beware biofilm! Dry biofilms containing bacterial pathogens on multiple healthcare surfaces; a multi-centre study. *Journal of Hospital Infection*. 2018;100(3):e47-e56.
14. Dancer SJ. The role of environmental cleaning in the control of hospital-acquired infection. *The Journal of Hospital Infection*. 2009;73(4):378-85.
15. Mitchell BG, Dancer SJ, Anderson M, Dehn E. Risk of organism acquisition from prior room occupants: a systematic review and meta-analysis. *The Journal of Hospital Infection*. 2015;91(3):211-7.
16. Mitchell BG, Digney W, Ferguson JK. Prior room occupancy increases risk of methicillin-resistant *Staphylococcus aureus* acquisition. *Healthcare Infection*. 2014;19(4):135-40.
17. White NM, Barnett AG, Hall L, Mitchell BG, Farrington A, Halton K, et al. Cost-effectiveness of an Environmental Cleaning Bundle for Reducing Healthcare-associated Infections. *Clinical Infectious Diseases*. 2019.
18. Brannigan ET, Murray E, Holmes A. Where does infection control fit into a hospital management structure? *Journal of Hospital Infection*. 2009;73(4):392-6.
19. Henderson J, Willis E, Roderick A, Bail K, Brideson G. Why do nurses miss infection control activities? A qualitative study. *Collegian*. 2020;27(1):11-7.

20. Zingg W, Holmes A, Dettenkofer M, Goetting T, Secci F, Clack L, et al. Hospital organisation, management, and structure for prevention of health-care-associated infection: a systematic review and expert consensus. *The Lancet Infectious Diseases*. 2015;15(2):212-24.
21. Mitchell BG, Farrington A, Allen M, Gardner A, Hall L, Barnett AG, et al. Variation in hospital cleaning practice and process in Australian hospitals: A structured mapping exercise. *Infection, Disease & Health*. 2017;22(4):195-202.
22. Aiken LH, Clarke SP, Sloane DM, Sochalski JA, Busse R, Clarke H, et al. Nurses' Reports On Hospital Care In Five Countries. *Health Affairs*. 2001;20(3):43-53.
23. Lee AS, White E, Monahan LG, Jensen SO, Chan R, van Hal SJ. Defining the Role of the Environment in the Emergence and Persistence of vanA Vancomycin-Resistant Enterococcus (VRE) in an Intensive Care Unit: A Molecular Epidemiological Study. *Infection Control & Hospital Epidemiology*. 2018;39(6):668-75.
24. Semret M, Dyachenko A, Ramman-Haddad L, Belzile E, McCusker J. Cleaning the grey zones of hospitals: A prospective, crossover, interventional study. *American journal of infection control*. 2016;44(12):1582-8.
25. Boyce JM, Havill NL, Lipka A, Havill H, Rizvani R. Variations in hospital daily cleaning practices. *Infect Control Hosp Epidemiol*. 2010;31(1):99-101.
26. Raveis VH, Conway LJ, Uchida M, Pogorzelska-Maziarz M, Larson EL, Stone PW. Translating Infection Control Guidelines Into Practice: Implementation Process Within a Health Care Institution. *Qual Health Res*. 2014;24(4):551-60.
27. Ong MS, Magrabi F, Post J, Morris S, Westbrook J, Wobcke W, et al. Communication interventions to improve adherence to infection control precautions: a randomised crossover trial. *BMC Infectious Disease*. 2013;13:72.
28. Gurses AP, Carayon P. Exploring performance obstacles of intensive care nurses. *Appl Ergonomics*. 2009;40(3):509-18.
29. Hall L, White NM, Allen M, Farrington A, Mitchell BG, Page K, et al. Effectiveness of a structured, framework-based approach to implementation: the Researching Effective Approaches to Cleaning in Hospitals (REACH) Trial. *Antimicrobial Resistance & Infection Control*. 2020;9(1):1-9.
30. White NM, Barnett AG, Hall L, Mitchell BG, Farrington A, Halton K, et al. Cost-effectiveness of an environmental cleaning bundle for reducing healthcare associated infections. *Clinical infectious diseases* : an official publication of the Infectious Diseases Society of America. 2019.

Table 1. Participant demographic data (n=96)

Gender	Number	Percentage
Male	8	8
Female	88	92
Prefer not to say	0	0
Age group (years)		
20-29	5	5
30-39	11	11
40-49	28	29
50-59	33	34
>60 years	19	20
Highest qualification		
Diploma	12	12
Bachelor level	30	31
Post graduate certificate/diploma	28	29
Masters degree	25	26
PhD	1	1
Usual place of work		
Hospital – public	56	58
Hospital - private	16	17
Residential aged care	8	8
GP practice	6	6
Medical centre/clinic	10	10
How long working for current employer		
<1 year	12	12
1-5 years	34	35
6-10 years	16	17
10 years plus	34	35
State or Territory of Australia		
Australian Capital Territory	5	5
New South Wales	37	39
Northern Territory	2	2
Queensland	7	7
South Australia	3	3
Tasmania	19	20
Victoria	13	14
Western Australia	10	10

Table 2. Method and product used for cleaning in different situations (n= 79)*

	Detergent based product only		Disinfectant only		Sporicidal disinfectant		Automated system e.g. Ultraviolet, Hydrogen peroxide vapour		Detergent/ disinfectant combined		Detergent followed by a disinfectant		Don't know		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Routinely for patient without a known infection	36	45.6%	11	14.0%	3	3.8%	1	1.2%	17	21.5%	6	7.6%	5	6.3%	79
Patient with VRE	3	3.8%	7	8.9%	10	12.7%	5	6.3%	28	35.4%	19	24.1%	7	8.9%	79
Patient with C.difficile	4	5.1%	4	5.1%	19	24.1%	3	3.8%	17	21.5%	23	29.1%	9	11.4%	79
Patient with a multi-drug resistant GRAM negative bacteria	6	7.6%	7	8.9%	10	12.7%	10	12.7%	24	30.4%	15	19.0%	7	8.9%	79

*not all questions were answered

Figure 1. Level of agreement to cleaning and disinfectant knowledge

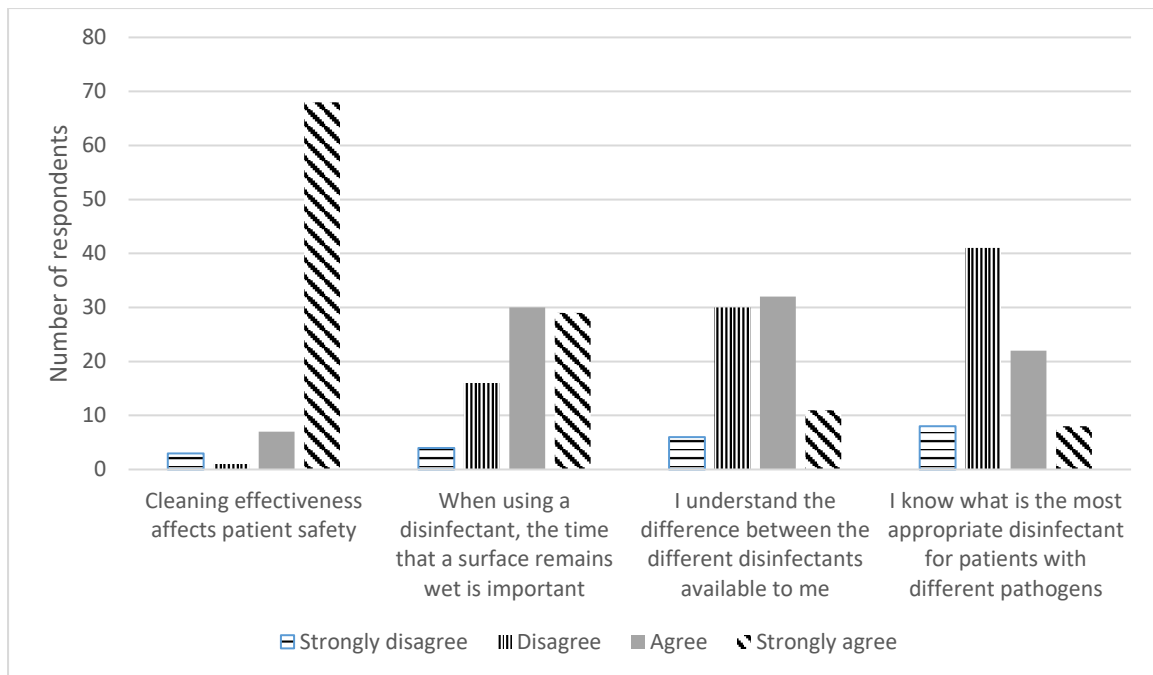


Figure 2. Examples of patient rooms and infection risks from environment. 96% of respondents (n=76) indicated Room A posed the greatest risk, 1% (n=1) for Room C and 3% (n=2) indicated they don't know.



Supplementary material

Table S1. How do you clean medical equipment in between use, for example a blood pressure cuff? (n = 79)*

	n	%
Wipes	64	81.0%
Cloth/paper towel and cleaning product	3	3.8%
Someone else's responsibility	0	0.00%
Probably don't clean	11	13.9%
Don't know	1	1.3%

*not all questions were answered

Table S2. Who provided the last training that you received on how to clean? (n = 79)*

	n	%
Infection Prevention Control team	20	25.3%
Colleague (informal training)	9	11.3%
Training department	6	7.6%
Not had any	14	17.8%
During basic training	16	20.2%
Company representative	8	10.1%
Search of the internet	6	7.6%

*not all questions were answered

Table S3. Personal efficacy, responsibility and confidence in performing effective cleaning (n= 79)*

	Never		Sometimes		Usually		Always		Total n	Weighted Average
	n	%	n	%	n	%	n	%		
I have to clean rooms/furniture that I have not been trained to clean	27	34.2%	26	32.9%	15	19.0%	11	13.9%	79	2.13
There is always enough time to completely clean a room before the next admission	14	17.8%	32	40.5%	19	24.1%	14	17.8%	79	2.42
I am confident in my ability to clean effectively	6	7.6%	19	24.1%	36	45.6%	18	22.8%	79	2.84
I would be comfortable being admitted to a room where the previous patient has a multi-drug resistant organism	33	41.2%	27	34.2%	11	13.9%	8	10.1%	79	1.92

*not all questions were answered

Survey Qualitative (free-text) comments (SQ).

SQ1. What would make the process of cleaning easier for you in your role? (Free-text, 79 answered).

Most participants perceived cleaning processes and effectiveness to be hampered by a lack of information and training, resources, and organisational structures.

Information, education and training

The most popular answers were those calling for readily accessible information and improved knowledge about cleaning products. Participants wanted product guides such as ‘a simple poster’ (answer number #20), wall chart (#74, #75), ‘flowchart of instructions’ (#11), or ‘chart that is easily carried’ (#32) with useful information about ‘...which products to use where and for what’ (#4) and ‘clear guidelines’ (#77, #79). One participant expressed the need for a ‘straight forward approach with easy instruction that everyone knows how to read’ (#25).

Improved labelling on products such as wipes and cleaning agents was also called for: ‘Knowing what cleaning agents are used for what types of contamination. Labelling on cleaning products themselves of what they can be used for’ (#30). One suggestion was to have ‘standardised cleaning agents’ (#29).

Participants also called for more education (#62) and training in the correct use of products and what different products are meant to be used for: ‘Understanding what products should be used for each type of infectious patient’ (#33). Clearer instructions were also needed about how to clean when caring for a patient with a known infection: ‘Clear instructions to accompany the MRO status of the patient’ (#60).

Resourcing

Product useability was a key feature. For example, some participants preferred single-use disposable wipes (e.g. Clinel wipes) because they were less fiddly to use (#24, #61), and generated lower aerosol levels in the environment (#53) than sprays and cleaning cloths. ‘Commercial products pre prepared and quick to use’ (#34) were also seen as making cleaning processes less burdensome. Having more staff – and particularly ‘dedicated cleaners’ (#3, #10, #36, #54, #66, #71) or ‘having a ward aid to do it’ (#17) – was also identified as a factor contributing to improved cleaning outcomes. This was especially the case where staff experienced time pressures (#31, #43, #45, #48). As one participant explained:

'More highly qualified certified experienced cleaning staff and or patient care assistants to help with bed change overs, patient discharge and carbolizing of patient beds and bed side tables. The nursing staff are so busy run off their feet managing obs[ervation] on pts, medication rounds, nursing notes, clinical pathways, nursing care plans, rapid response, ICU Assist. That when it comes to bed change and carbolizing it would be such a great assistance if there were more positions dedicated to these tasks in both private and public hospitals. Also, more readily available linen, towels and hand sanitizer at all patient bays or corridors' (#76).

Access to cleaning products, equipment, and time (organisational practices, patient demands) were often listed in combination.

Organisational issues

Organisational issues had the least number of comments, regarding lack of management's recognition, resourcing and support for cleaning practices, lack of clear policies and guidelines to guide cleaning and infection control practices, lack of communication, and lack of clear role definitions and staff accountability. Comments included the need for 'Designated role and accountability, cleaning guidelines' (#78), 'a clear policy' (#79) and for 'Everyone seeing the process of cleaning as part of their role. Not making work for others or leaving it for someone else to do' (#55).

SQ2. What prevents you from being able to clean equipment between patients? (free-text, 79 answered)

Time and organisational resources (availability of cleaning products and equipment, access to these) were the two most reported answers, followed by organisational aspects such as lack of staffing and bed pressures, not allowing adequate time between patients for nurses or staff to clean.

Nothing

In contrast, some participants wrote that 'nothing' (answer number #4, #20, #68) impacted their ability to clean equipment between patients. Cleaning occurred even when staff were pressed for time: 'NOTHING prevents me from cleaning equipment in between patients. I always do' (#5), 'nothing, I always clean equipment between patients' (#22, #29), and 'Time can be a factor in the ability to clean but we ensure that patient areas are all cleaned before a new patient is transferred into the area' (#24). Another participant wrote: 'Do clean in between patients but sometimes may not be as thorough due to time constraints' (#48). Lack of time was an important factor, as shown below.

Time

Time was often cited, either by itself or in conjunction with other issues such as patient-staff ratios or not having cleaning products and equipment close to hand. For example: 'time and access to products' (#3), 'right equipment and ability in terms of time as patients are usually waiting' (#12), 'New patient already waiting for cubicle' (#16), 'Time and availability of cleaning wipes' (#37), 'Lack of time. High clinical workload' (#40), 'Time to do this and easy access to resources for cleaning...time to get product' (#50), and 'Time. Lack of products. Waiting for contact times to elapse' (#61) and 'The speed of a new admission into a vacated room' (#72).

Two participants pointed to limitations in work-flow processes relating to patient surgery and discharge that impacted on their ability to effectively clean:

'Time. Escorting discharged patients post procedure out of the facility and into the care of relatives, on return to unit another patient has been transferred from the OR [operating room] to the vacated seat before cleaning can be done'. (#18)

'Time constraint, surgeons and sometimes anaesthetist are impatient and want too quick changeovers, more equipment e.g. ECG leads, BP cuffs, so they can be sanitised and allowed to air dry instead of having to be used for every patient' (#53).

Resources

Product resourcing (availability and access) was another common issue that impacted on staff's ability to effectively clean between patients, for example: 'not having a product or something to clean close at hand' (response number #1), 'availability of product at the point of use' (#67), 'disinfectant wipes not available – e.g. to clean BP cuff, etc.' (#9) and 'not enough cleaning products' (#69). A lack of necessary equipment to perform cleaning tasks effectively was also noted, for example:

'Time. Lack of spare or clean equipment' (#30).

'So very time poor, high patient load, 4 hour rule in ED is pushing patients through extremely quickly and no time to wash or clean anything!!! There is very little equipment to replace equipment that is being washed' (#42).

Organisational aspects

Some participants perceived that organisational structures (such as staffing ratios and management support) impacted on their ability to clean equipment between patients, for example: 'Time and lack

of support/financial assistance from management' (#26) and 'Time & staffing' (#26). The lack of trained, dedicated cleaning staff was also problematic:

'Time, lack of cleaning product on wards. Lack of the obvious factor that there is not enough trained qualified PCA staff hired on the wards that the nurses can delegate these important infection cleaning control tasks to complete' (#76).