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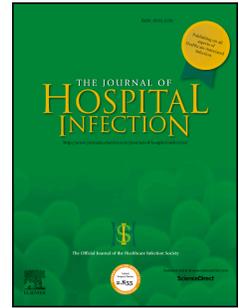
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SUMMARY

Background

Now that cleaning and decontamination are recognised as integral to infection control, it is timely to examine the process in more detail. This is because cleaning practices vary widely within healthcare districts and it is likely that both time and energy are needlessly wasted with ill-defined duties. Furthermore, inadequate cleaning will not reduce the infection risk but may even enhance it. The process would benefit from a systematic appraisal, with each component placed within an evidence-based and ordered protocol.

Methods

A literary search was performed on 'hospital cleaning', with focus on manual aspects of cleaning, pathogen reservoirs and transmission, hand-hygiene, staff responsibilities and patient comfort.

Results

There were no articles providing an evidence-based practical approach to systematic cleaning in hospitals. This review therefore proposes a simple four-step guide for daily cleaning of the occupied bed space. Step 1 (Look) describes a visual assessment of the area to be cleaned; step 2 (Plan) argues why the bed space needs preparation before cleaning; step 3 (Clean) covers surface cleaning/decontamination; and step 4 (Dry) is the final stage whereby surfaces are allowed to dry.

Conclusion

Given the lack of articles providing practical cleaning guidance, this review proposes a four-step protocol based on evidence if available, or justified where not. Each step is presented, discussed and risk-assessed. It is likely that a systematic cleaning process would reduce the risk of healthcare-acquired infection for everyone, including outbreaks, in addition to heightened confidence in overall quality of care.

INTRODUCTION

Hospital cleaning has assumed more importance with the realization that pathogens survive in the healthcare environment and contribute towards the risk of hospital-acquired infection (HAI).^{1,2} The environment enables transmission of the most important healthcare-associated pathogens.³ These pathogens can persist on surfaces for weeks and represent a transmission risk for both patients and staff.² Environmental screening confirms repeated contamination of items, equipment, and general sites in bed spaces and rooms of colonized or infected patients and throughout multiple clinical areas in a healthcare institution.^{1,3,4} The highest risk sites for contamination are those situated nearest to the patient.⁴⁻⁶ Healthcare workers, visitors and patients themselves touch these surfaces and transfer them to other sites, which increases the risk of onward transmission.⁷⁻¹⁰

While keeping hospitals clean was originally regarded as an aesthetic necessity, it is now accepted that targeted and frequent cleaning can reduce bioburden in the healthcare environment and associated risk of healthcare-acquired infection (HAI).^{3,11,12} Evidence supporting cleaning has accumulated over the past decade, along with more traditional infection prevention activities such as hand hygiene, barrier nursing, screening and isolation.^{13,14} Indeed, even exemplary hand hygiene will not protect patients from acquiring a specific pathogen if their room was previously occupied by a patient with the same pathogen.¹⁵ The cleaning process itself is subject to debate over which methods should be used; how often it should be performed, and by whom; and the choice of equipment, cleaning fluids and wipes, benchmarks, monitoring and risk-based standards.¹⁶⁻¹⁸ Cleaning practices vary considerably, even within the same hospital and health district, and these rely heavily upon available resources and managerial support.^{3,18}

Cleaners themselves receive little or no training for what they do, and any teaching initiatives may be compounded by time, language and literacy problems.¹⁹ Universally poorly paid, they are expected to perform a physically arduous and repetitive job with additional personal risks from cleaning materials as well as exposure to infected patients.¹⁷ Cleaning staff would likely welcome a systematic aid to good practice with in-built risk assessment for themselves, as well as staff and patients. The four-step guide that is presented here is aimed primarily at cleaning rather than nursing staff, and as such prioritizes bed space items and furniture and not clinical equipment. These statements are supported by published evidence gleaned from the original search, or with basic hygiene principles, if not, and offer a practical approach to alleviating the risk from environmental contamination of surfaces beside the patient.²¹

METHODS

The literature was subjected to a search for practical guidance on cleaning the occupied bed space. We found no relevant articles, which prompted us to develop the four-step guide for daily cleaning of the occupied patient bed space that is presented here.

RESULTS

Four steps to clean

Why do we need a guide for routine cleaning of a bed space? Firstly, because repeated application of a sequential cleaning system would offer a time-efficient and effective method for decontaminating a bed space in the healthcare environment.²² We already know that surfaces are regularly missed during cleaning and that time spent cleaning does not correlate with thoroughness of cleaning.^{23,24} Cleaning an area in a methodical pattern establishes a routine so that items or areas are not missed during the cleaning process.²² A practical guideline would improve cleaning of high-risk near-patient sites and could impact on HAI risk. Secondly, an explanatory guide would help cleaning staff understand what they should do; when they should do it; and why they should do it. The principles focus on the occupied bed space, because a vacant bed space receives so-called 'terminal' or 'discharge' cleaning, for which there is already comprehensive guidance. An unoccupied bed space is easier to clean, since it lacks patient, visitors, clinical equipment and personal belongings. However, while there remains a small HAI risk for cleaning staff from the terminally cleaned bed-space, the risk is arguably greater with a patient in-situ.^{15,25} Patients themselves continually touch high-risk sites, without hand hygiene reminders or opportunities. The four steps are LOOK; PLAN; CLEAN and DRY (Table I).

STEP 1: LOOK

A visual assessment is the first stage of the cleaning process. Every cleaner should inspect the area to be cleaned and consider overall conditions and degree of visual contamination before beginning a cleaning task. Conscious attention to visual dirt, spillages and rubbish will help to target cleaning attention, as will the arrangement of beds and clinical equipment (Figure 1). This initial assessment requires adequate lighting, whether natural daylight or artificial light. Cleaners should also evaluate the cleanliness of a room by ambient temperature, smell and patient status; patients may be asleep, absent, immobile, mobile, undergoing clinical intervention, unconscious, or dying. There may be

staff and/or visitors present. It is important to consider noise control; cleaning activities and/or equipment may potentially upset a sick patient and disrupt visiting or clinical care.

The overall impression allows a cleaner to initiate cleaning or not, guided by ward staff if necessary. Cleaners should always seek advice for patients in isolation rooms, because it is not always obvious why a patient has been isolated. Rooms accommodating patients with HAI may demand a different cleaning and decontamination regimen than patients in multiple-bedded bays or wards. Provided cleaning access is timely and appropriate, the decision to clean will be followed by step 2, which requires the cleaner to adjust the area in preparation for the cleaning process.

STEP 2: PLAN

This step explains why and how the area to be cleaned needs to be prepared for cleaning. The first action is to wash hands; unless the cleaner has just done so, and assumes that hand washing facilities, including clean water, are readily accessible. Hands should preferably be washed with liquid soap and water rather than cleaned with hand hygiene products.²⁶ While hand gels offer an alternative option, alcohol-containing products may be inactive against some pathogens, notably norovirus and *C. difficile*. The cleaner should then don gloves and aprons, and/or other barrier protection in accordance with local policy.

Preparation for cleaning begins with attention to lighting, unless already resolved. Thus, blinds or curtains should be opened or lights switched on (or off) unless there are good reasons not to do so. Strong smells and/or temperature may guide the cleaner to open a window(s) if possible.²⁷ Balance between natural ventilation, smell and temperature should be assessed by the cleaner in line with patient comfort, aided by discussion with the conscious patient and/or advice from clinical staff.

Next, furniture and beds may require realigning if they are blocking access to sites intended for cleaning. Moving and handling of furniture must comply with local policy so that cleaners are not expected to perform major manoeuvres for the sake of cleaning. Bed rails may need to be raised to protect the patient before elevating the bed for easier access to the underside. It may also be necessary to reposition clinical equipment (e.g. intravenous drip stands, fans, respiratory aids) or patient devices (e.g. catheter bags). Cleaning staff should not handle such clinical items, and must be able to call on assistance from clinical staff where necessary. Similarly, cleaners may need support from clinical staff if the patient's belongings need moving. Near-patient surfaces offer the greatest risk for contamination so cleaning sites such as the bedside locker and table should not be omitted just because they are covered with patient belongings (Figures 2 and 3). Personal items can be

placed on another surface such as a chair, window sill, ledge or shelf, but of course never on the bed or on the floor.

Once the room or bed space has been organized for access, bins should be checked and emptied and visible rubbish on the floor and other surfaces removed. It is appropriate to ask the conscious patient, and visitors, if there are any unwanted items requiring disposal. This includes food and liquid waste and spillages of either. Spillages of blood and body fluids require attention from nursing staff and should be reported immediately; cleaning should cease until such spillages have been decontaminated. Clinical staff should identify to cleaning staff any specific bed spaces that might require enhanced cleaning. In addition, cleaners should be aware of any areas that are challenged by plumbing leaks and building works, or contaminated air, spillages and footwear.²⁸

Final preparations include replacement of rubbish bags, soap, paper towels and toilet paper; and collection of discarded crockery, glasses, cutlery and water jugs, unless these duties are assigned to other staff. Similarly, dirty linen and towels should be removed and placed in appropriate receptacles, unless linen disposal is managed by other staff. At this point, staff may collect equipment and cleaning consumables and bring them into the room. All cleaning tasks need the right tools for the job. Cleaning fluids should be freshly prepared from in-use supplies; with attention towards time-expiry for chosen consumables. Equipment itself should be clean and in a good state of repair. Sufficient clean water, fresh cloths or wipes and mop heads should be readily available for cleaning staff with clear instructions on how to manage disposable and non-disposable items.

STEP 3: CLEAN

Cleaning refers to the removal of soil from surfaces by use of physical wiping or scrubbing, the chemical action of a surfactant or detergent, and water to wet, emulsify, or reduce surface tension.¹⁷ The process removes both dirt and microorganisms from surfaces, thereby reducing the amount of organic bioburden. Cleaning should always precede disinfection because the presence of soil will impede disinfectant activity.²² Some hospitals use detergents for routine cleaning while others choose products that either inactivate or kill living microorganisms. This is termed disinfection or 'hygienic' cleaning. Unlike detergent-based cleaning, efficacy requirements are set out by harmonized European test standards, which include differential surface loading with albumin and sheep erythrocytes. Cleaning and disinfection become inextricably intertwined when wipes are impregnated with disinfectant since the overall effect is a combination of disinfectant activity as well as physical removal of soil from the wipe.²⁹

There are some general principles generally accepted as good practice whether detergent-based cleaning and/or disinfection cleaning are chosen, as follows:^{22,30}

A. Direction of cleaning

- i) Begin cleaning at the furthest end of the bed space working towards the exit.³⁰
- ii) Clean from high (hand height) to low, i.e. do not start with the floor.
- iii) Clean sites nearest the patient first, e.g. bed head, nurse call button, locker; then sites furthest from the patient, e.g. door handle, sink, bathroom.^{5, 31}
- iv) Make hand-touch sites a priority, i.e. work to a check list (Table II).^{32,33}
- v) Clean a site from least visually dirty to obviously dirty.

B. Wiping action

- i) Wipes should be used according to manufacturers' instructions.
- ii) Use one wipe for each site; some sites may require several wipes, e.g. bed frame.
- iii) Unfolding the wipe and using it flat on the surface maximises the area cleaned and minimises the amount of hand contact.
- iv) Wipe in one direction without retracing area already cleaned; wipe a large flat surface using an S-shaped pattern (Figure 4).^{22,34-36}
- v) Apply the 'One wipe; one site; one direction' principle.^{34,37-39}
- vi) Throw away disposable wipes after each site or if visibly soiled; or, if a single cloth is used, decontaminate between each site or discard and chose a fresh cloth.²²
- vii) Be aware that microbes may be transferred between surfaces (via gloved hands, cloths, etc.).^{29, 35-37}

C. Detergent versus disinfectant

- i) Detergent is used for physically removing soil; disinfectant is for killing microbes.⁴⁰
- ii) Impregnated wipes should be used according to manufacturers' instructions, including drying time.
- iii) Cleaning fluids should be prepared; applied; and discarded according to manufacturers' guidance and in adherence with local policy.
- iv) Water and detergent are adequate for *routine* bed space cleaning provided the 'One wipe; one site; one direction' principle is applied.^{34,37-39}
- v) Always remove visible soil with detergent and water before disinfectant use.^{22,40,41}
- vi) The physical removal of soil and microbiocidal activity from disinfectant may be achieved by use of a disinfectant-containing wipe.^{29, 34}

- vii) Wiping an area >30 cm² reduces the microbiocidal effect of a disinfectant wipe.⁴²
- viii) Use disinfectants for infected patients or during an outbreak, unless local policy dictates routine disinfectant use for high risk patients or sites, e.g. sinks, showers and toilets.

D. Floors and bathrooms

- i) Ensuite bathrooms are cleaned after the patient room, beginning with the sink, then shower/bath and finally the toilet. Local policy should guide disinfectant choice.
- ii) As with the near-patient environment, prioritise the hand-touch sites in the bathroom, i.e. taps, handles, nurse call button, grab bars, toilet roll holder, etc.
- iii) Floor cleaning is the last task to complete.
- iv) Place warning signage before floor mopping begins; verbally warn staff, patients and visitors if floors are wet.

Sites such as bed rails, bed control (if electric bed); nurse call bell; bedside locker and bed table constitute the highest priority for cleaning because they are frequently touched and readily provide a reservoir for hospital pathogens.^{3-6,31,33,43} There is a two-way direction of transmission between these surfaces and hands, which can only be disrupted by targeted cleaning and hand hygiene. Given that cleaning usually occurs just once a day, and hand hygiene depends on a multitude of factors, it comes as no surprise that infections are readily acquired from bed space sites.^{5, 7, 15, 25} Table 2 offers a sequential system for cleaning the highest risk hand-touch sites in a bed space.

Comprehensive coverage removes both organic soil as well as microbial contamination including planktonic organisms released from biofilm. Physical removal of soil during routine cleaning is preferable to application of disinfectants unless the patient is colonised or infected with transmissible pathogens.^{34,37,40,43-48}

STEP 4: DRY

The final stage encompasses physical drying using clean paper towels or cloths as well as time for drying of cleaning fluids (detergent and/or disinfectant) on surfaces. The cleaning process is not complete until all surfaces are completely dry. Contact time is usually considered critical to disinfection, but it can be difficult to fulfill in a time-pressured health care environment.^{17,22,32,40}

While the drying time may or may not impinge on disinfection, surfaces should still be allowed to dry if only for safety reasons.⁴⁹ Time for drying could reasonably be utilized by removal of cleaning equipment and fluids to outside the bed space area or room; discarding used wipes; cloths; mops; linen; towels; and liquids. Reusable equipment should itself be inspected, cleaned and dried before

further use if necessary. Once cleaning utensils have been removed, surfaces can be visually assessed for dampness. If surfaces look and feel dry, then furniture (and bed) can be repositioned, doors and windows adjusted, and signage removed; patient belongings should be returned to the top of the locker or bed table, with the host site wiped over and similarly allowed to dry.

This fourth stage should also include the cleaner's own assessment as to overall cleanliness of the bed space or room (Figure 5). If they are satisfied that the process is complete, the area can be signed off verbally or by written notification, labeling or use of a check list. Further monitoring helps maintain, and improve, the quality of cleaning but it is not necessarily mandatory and will depend upon available resources.³ Any problems with cleaning should be reported to clinical staff and/or cleaning supervisors. This would include non-completion due to lack of access; patient status; or malfunction or breakages of bed space and bathroom items or cleaning equipment. Cleaners have a duty to report sites that are missed during cleaning, as well as items or surfaces that are difficult to clean; there may also be difficulties with waste removal such as discarded clinical dressings. They should also mention any sightings of pests such as mice and insects.⁵⁰

When leaving the patient area, the gloved hand should be subjected to hand disinfection if the cleaner has to fulfill further duties before the next cleaning objective. Otherwise gloves and any other protective apparel may be removed and hands washed and dried before further duties.

Discussion

The importance of cleaning has been reinvented over the last decade and is now generally accepted as a key component of infection prevention. Everyone works better in a clean environment; and visitors notice even if patients (and staff) do not. Aside from aesthetic appearance, the propensity for pathogens to contaminate the environment represents a major risk of infection for patients.⁵⁰ In her seminal 'Notes On Nursing', from 1860, Florence Nightingale wrote that 'the greater part of nursing consists in preserving cleanliness'.⁵¹ Just a few colony forming units of *S.aureus* or less than 10 spores of *C.difficile* are sufficient to initiate infection and transfer is facilitated by reservoirs within the patient zone.^{3,5,7,11} The four steps proposed in this article are an attempt to define and simplify a cleaning strategy for an occupied bed space, whether within a multi-bedded unit or a single room. Each step is supported by scientific evidence if it exists, and common sense, where it does not. The intention is to present a systematic guide that targets the highest risk sites in an ordered process; the aim of which is to reduce near-patient contamination and risk of infection. Standardization is urgently needed for cleaners on an international basis, since there is currently no universal agreement on healthcare cleaning methodologies.¹⁸

Evaluating the outcome of this protocol is beyond the scope of this article but could conceivably be the fifth step in the process.⁵² Environmental monitoring can focus on the impact of cleaning itself (direct observation or fluorescent markers); on surface cleanliness after the cleaner has left (measurement of organic or specific microbial soil); or on HAI rates as part of a structured and controlled surveillance system.^{3,16,52} The efficacy of any cleaning protocol requires robust assessment before widespread adoption by environmental services. These four steps would also benefit from further development as hospital routines evolve and new decontamination methods and equipment become available.

Special education, repeated training and supervision for hospital cleaners is at best infrequent and at worst inadequate (or non-existent) despite the importance of maintaining a safe and pleasing environment for everyone.^{3,18,53} Embedding a systematic cleaning protocol into a training schedule would provide trainers and supervisors with a simple and effective teaching aid for cleaning staff, with each step illustrated by figures, photographs and/or video. The aid could also cover cleaning, storage and maintenance of equipment, since dirty utensils compromise any cleaning attempts. The same applies to the water supply and management of cleaning fluids.

This type of education is primarily aimed at cleaning staff, but could also be offered to clinical staff and students in related healthcare disciplines. In some hospitals, bedside cleaning is performed by nurses or clinical support staff; it is hoped that these, and others, would benefit from having a systematic check list based on known risks. Although cleaning guidelines can always be further developed, practical recommendations to improve cleaners' motivation, (self) training, and audit (part of training) and guidance to positively value cleaners' tasks should also be considered.

While this guide has not included directives on equipment or consumables, there are choices to be made regarding both. There is evidence to show that daily cleaning performed using detergent and water is sufficient to control total bioburden as well as some pathogens.³⁸ The underlying principle remains focused on removal of dirt rather than destruction of surface microbes.^{40,44} This is because repeated exposure of environmental flora to microbiocidal products encourages tolerance and even cross-resistance to antimicrobial agents.⁵⁴ Daily use of powerful disinfectants might even consolidate endemic problems with environmental organisms such as VRE and Acinetobacter.⁴⁰ However, detergent cleaning should be temporarily replaced with disinfectant if the patient is known to harbour a transmissible pathogen, or if the patient is involved, or might be involved, in an outbreak.^{54,55} The wiping strategy remains the same but removal of soil should be followed by application of an appropriate disinfectant.⁵⁶ The fourth step would then encompass 'contact time' as well as surface drying in order to allow the disinfectant to kill surface pathogens. Specific

requirements for chosen disinfectants should be included in the training aid in accordance with infection control advice. The effect of disinfectant agents on cleaners' health and wellbeing is another important factor not covered in this article. Toxicity issues should be considered in disinfectant choice, with effective protection readily available for cleaning staff if required.^{17,57}

A practical cleaning guide might help to reduce the risk of HAI from inadequate hand hygiene. This is highlighted by poor compliance for the Fifth Moment of hand hygiene, namely that of cleaning hands after touching the near-patient environment.^{20,21} If staff are appropriately trained and monitored, a systematic cleaning specification would alleviate day-by-day contamination as well as complement concurrent hand hygiene initiatives. The Five Moments themselves provide a logical analogy with 'when to clean' indications, in that staff should always consider the cleanliness of high-risk near-patient sites during patient care; before performing aseptic activities; after discharge of patients; after visible surface contamination; and as part of the multi-barrier strategy to control outbreaks.²⁰ This analogy further strengthens the principle of a balanced relationship between hand hygiene and cleanliness of hand-touch sites and neither should be prioritised over the other.⁵⁸

Risk-based cleaning has not yet been universally agreed or documented and yet it offers an additional opportunity for managers to engage with, and support, infection prevention and control throughout the healthcare environment. Given the increasing concern with antimicrobial resistance, a step-by-step cleaning protocol is a straightforward cost-effective addition to all the other established activities imposed on hospitals to reduce HAI.

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Conflicts of interest

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Table 1: 'Look; Plan; Clean; and Dry' System for cleaning an occupied bed space

1. LOOK

Visual assessment: general impression incl. temperature; smell; visible debris; clutter; space; lighting; patient status; and presence of clinical staff and visitors.

2. PLAN

Organise and prepare for cleaning: wash hands; realign furniture, equipment and patient's belongings for access; removal of litter, food, spillages, debris, etc. Replenish supplies if needed.

3. CLEAN

i) Cleaning: removal of dirt, smears, stains, grease, dust, etc. according to local policy.

ii) Disinfection (if required): applied according to manufacturer's recommendation.

4. DRY

Dry: time for physical drying (water and cleaning fluids). Replace items if moved for cleaning. Assess area, remove equipment and wash hands.

Table 2: Order for Cleaning the Patient Bed space

1. Bed frame starting from head to feet (including bed control and patient notes fixtures if present)
2. Patient appliances (nurse call, light switch, etc.)
3. Bedside locker from top downwards
4. Bed table including underneath and hand adjustment
5. Furniture (visitor chairs)
6. Window/blind/shutter handles and window sill
7. Door handles/push plate

Figure legends**Figure 1: Impediments to cleaning**

Photo credit: Author (SD)

Figure 2: Cluttered bed space

Photo credit: <http://www.cbsnews.com/news/in-us-hospital-acquired-infections-run-rampant/>

Figure 3: Patient belongings on bedside locker

Photo credit: Author (SD)

Figure 4: The S-shaped method for cleaning a flat surface

Photo credit: Gama Healthcare

Figure 5: Cleaned bed space

Photo credit: Author (SD)

Figures for 4 steps (figure legends on last page of article)

Figure 1



Figure 2



Figure 3



Figure 4

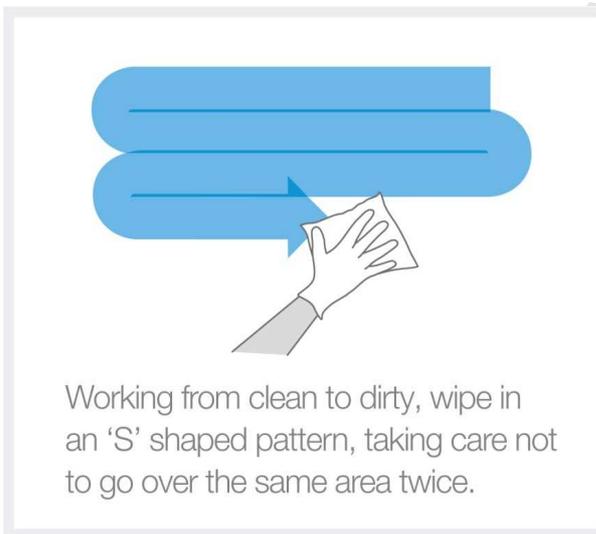


Figure 5



ACCEPTED