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Short Report

Cleaning time and motion: an observational study on the time required to clean shared medical equipment in hospitals effectively

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SUMMARY

Background: Despite the important role that cleaning plays in reducing the risk of healthcare-associated infections, no research has been undertaken to quantify the time required for effective cleaning and disinfection of different pieces of shared medical equipment commonly used in hospitals. This short report presents the results from a study that aimed to quantify the time required to clean common pieces of shared medical equipment effectively.

Methods: An observational time and motion study was conducted in a nursing simulation laboratory to determine the time required for effective cleaning and disinfection of 12 pieces of shared medical equipment commonly used in hospital. After training, the participants cleaned and disinfected equipment, with the time taken to clean recorded. Cleaning was deemed to be effective if ≥80% of ultraviolet fluorescent dots were removed during the cleaning process.

Main results: The time to clean equipment effectively ranged from 50 s [blood glucose testing kit; 95% confidence interval (CI) 0:40–1:00 (min:s)] to 3 min 53 s [medication trolley; 95% CI 3:36–4:11 (min:s)]. The intravenous stand was cleaned most effectively, with 100% of dots removed ($N = 100$ dots). In contrast, the bladder scanner was the most difficult to clean, with 12 attempts required to meet the 80% threshold for effective cleaning.

Conclusion: This study will inform staffing and training requirements to plan the cleaning and disinfection of shared medical equipment effectively. The findings can also be used for business cases, and in future cost-effectiveness evaluations of cleaning interventions that include shared medical equipment.

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Introduction

Contaminated hospital environments play a major role in the transfer of pathogens to patients. Pathogens can survive for extended periods of time in the hospital environment, where they can be transferred to patients [1]. Despite this, the effect of cleaning and disinfecting shared medical equipment in reducing healthcare-associated infections (HAIs) is rarely described in the literature, and there is a lack of randomized controlled trials in this area [2]. Recently, a randomized controlled trial (CLEEN study) was undertaken to determine the effect of improving the cleaning and disinfection of shared medical equipment on the incidence of HAIs [3,4]. During the CLEEN study, the thoroughness of cleaning was monitored, but the time required to do this was not measured.

Despite guidelines worldwide identifying and recommending the importance of environmental cleaning, there is limited evidence that quantifies the time required for effective manual cleaning of equipment. A study undertaken in Scotland in 2017 measured the mean time to clean equipment commonly found in patients' rooms, but did not focus on pieces of equipment that were stored in common areas, shared between patients daily, and were normally the responsibility of nursing staff [5]. Shared medical equipment is normally cleaned between patients, and therefore by the user (e.g a nurse or physiotherapist, rather than an environmental services worker). To supplement gaps in the research, this study aimed to investigate the time required to clean and disinfect different types of shared medical equipment effectively.

Methods

Design and setting

This observational time and motion study ran for 4 h in a nursing simulation ward at a university in New South Wales, Australia. Ethical approval was granted by Avondale Research Ethics Committee (ETH.2023.012).

Participant recruitment

Six nursing students were recruited through advertisements and promotion of the study via professional networks and social media. For feasibility, a minimum of six participants were recruited, with written consent obtained prior to the study. All participants were aged >18 years.

Training, intervention and data collection

Participants received 1 h of in-person training, focusing on the principles of cleaning and disinfection. This was led by a research team member with expertise in effective cleaning processes. Two-in-one disinfectant wipes (Clinell Universal Wipes, GAMA Healthcare, Notting Hill, Victoria, Australia) were used to clean equipment in accordance with the equipment manufacturer's instructions. Two-in-one wipes contain a detergent and disinfectant. Wipes were chosen to clean equipment in this study as they are commonly used in hospitals for this purpose [6]. Training covered: types and frequent touch points of shared medical equipment; fomite transmission from shared medical equipment; wipes used; cleaning technique; contact time; and audit procedure.

Training and procedures focused solely on the exterior of 12 different pieces of equipment: bladder scanner; blood glucose testing kit; blood pressure monitor; commode; computer on wheels; infusion pump; intravenous stand; medication trolley; metal trolley; patslide; resuscitation trolley; and wheelchair. Where applicable, the contents of drawers were not cleaned. Participants were under direct observation during cleaning.

Cleaning efficacy was monitored using an EvaluClean kit (GAMA Healthcare). This process is used frequently in hospitals to evaluate cleaning efficacy [7]. Ten ultraviolet fluorescent marker (FM) dots were applied to the frequent touch points of each piece of equipment and allowed to dry prior to cleaning. Once dried, these FM dots were only visible under ultraviolet light, were resistant to dry abrasion, and could be removed completely during routine cleaning processes.

Six participants cleaned all 10 different pieces of equipment at least once. The duration of cleaning and disinfection was recorded using a stopwatch. The research team then assessed the equipment and recorded how many FM dots had been removed. Equipment was considered to have been cleaned effectively when ≥8 dots (≥80%) had been removed completely. Eighty percent was selected as the threshold, as this is consistent with the best results obtained from cleaning studies exploring FM technology [7,8]. This process was repeated until each piece of equipment had been cleaned effectively 10 times. Only data from pieces of equipment that had been cleaned effectively were included in the analysis of time taken to clean.

Data analysis

Descriptive analysis was undertaken to determine the mean, range and variance for the time needed to clean different pieces of shared medical equipment effectively. Statistical analysis was undertaken using SPSS (IBM Corp., Armonk, NY, USA). Ninety-five percent confidence intervals (95% CI) around the mean confirmed that the time required to clean and disinfect equipment fell within the suggested range.

Results

All pieces of shared medical equipment were cleaned and disinfected effectively in <4 min (Table I). The blood glucose testing kit required the shortest time to clean [95% CI 0:40—1:00 (min:s)] and the medication trolley required the longest time to clean [95% CI 3:36—4:11 (min:s)]. The intravenous stand was cleaned most effectively, with 100% mean cleaning efficacy (95% CI 100—100%) (Table S1, see online supplementary material). The bladder scanner required 12 cleaning attempts to reach the 80% cleaning threshold, with mean cleaning efficacy of 76% (95% CI 67—85%).

Discussion

This study fills a fundamental gap in knowledge of the time requirements for effective cleaning and disinfection of common pieces of shared medical equipment. Several factors were considered to ensure that this study reflected 'real life' as

Table I
Time required to clean shared medical equipment in hospitals effectively

Type of equipment	Mean time to clean effectively[a] (min:s)	Standard deviation (min:s)	Minimum cleaning time (min:s)	Maximum cleaning time (min:s)	95% confidence interval (mean) (min:s)
Blood glucose testing kit	0:50	0:14	0:27	1:10	0:40–1:00
Intravenous stand	1:20	0:30	0:40	2:01	0:59–1:41
Infusion pump	1:21	0:28	0:31	2:06	1:01–1:41
Blood pressure monitor	1:49	0:19	1:00	2:13	1:35–2:02
Patslide	2:17	0:24	1:38	3:00	1:59–2:34
Metal trolley	2:19	0:49	1:38	4:20	1:44–2:55
Wheelchair	2:29	0:45	1:21	3:38	1:57–3:01
Resuscitation trolley	2:29	0:32	2:01	3:50	2:35–3:20
Computer on wheels	2:43	0:45	1:46	4:00	2:11–3:15
Commode	2:58	0:43	2:18	4:20	2:28–3:30
Bladder scanner	3:16	0:53	2:09	5:01	2:39–3:54
Medication trolley	3:53	0:30	3:15	4:28	3:36–4:11

Note: Included timepoints met the 80% cleaning threshold.
[a] $N = 10$.

much as possible. In the education session, participants were advised not to rush through cleaning, and rather to focus on cleaning the equipment thoroughly. Training was consistent with initial training provided in other studies and in hospitals to cleaning staff [4,8]. The choice to use a pre-prepared wipe enabled this study to focus on the time taken to clean, rather than the time taken to prepare products or approaches, which can vary considerably and is in addition to the actual cleaning process. The use of a time and motion approach through direct observation has the advantage of being objective.

Global guidelines recommend that non-critical shared clinical equipment should be cleaned and/or disinfected between patient uses [1]. However, there is ambiguity as to who is responsible for cleaning, and these pieces of equipment are often overlooked or have low priority in under-resourced wards [9]. A survey of Australian nurses and midwives revealed that they understood the importance of cleaning; however, there was uncertainty regarding appropriate product choice, cleaning technique and responsible persons [10]. Additionally, studies assessing the effectiveness of cleaning have shown that nurses are less effective than trained environmental service workers, indicating a lack of time, training or other factors [11].

The cumulative time to clean and disinfect 120 pieces of medical equipment (12 different pieces of shared medical equipment, cleaned 10 times) was 4 h: 41 min: 58 s. This is a considerable time requirement to enforce with the 'clean between use' approach, and is limited by workload and staffing. It is clear that better evidence is needed to inform the value of cleaning and disinfecting shared medical equipment in reducing HAIs, as well as an exploration of different models of service delivery to achieve this. Hospitals and other healthcare institutions may benefit from dedicated cleaning teams to improve the cleaning efficacy of shared equipment, if workload or other factors inhibit healthcare workers from cleaning such equipment. This approach may be useful to ensure that equipment is cleaned regularly, as studies have demonstrated that cleaning may not take place between multiple patient admissions [11]. This study also identified differences in the time taken to clean different pieces of equipment, potentially reflecting how the complexity of the equipment may influence the time needed for cleaning.

Regular training, auditing and feedback are needed to enhance and maintain the thoroughness of cleaning [3,6,8]. A recent review highlighted the benefits of multi-modal cleaning bundles and important considerations for designing meaningful and sustainable environmental programmes for healthcare facilities [6]. The present study provides an important contribution to guide hospitals on the time requirements of cleaning shared medical equipment. As the responsibility for cleaning shared equipment often lies with clinical staff, this study identified a potentially unrecognized amount of time that should be factored into clinical staff time for cleaning. Alternatively, this study provides data for alternative methods to achieve this. When used in combination with evidence-based guidelines, hospitals will have the necessary resources to plan a patient-centred and cost-effective approach to prevent the transmission of HAIs via shared medical equipment.

This study has limitations that should be considered when applied by different institutions. Participants knew they were being audited, increasing the Hawthorne effect [6,7]. However, this study focused on the time taken to clean effectively, so the Hawthorne effect plays little role in the primary outcome of interest – time. In contrast, the efficacy of cleaning is likely to be affected by direct observation, and cleaning in the real-world clinical environment may not achieve the same thoroughness. Interactions with patients and/or staff could not be modelled in the present study, which may further increase the time taken to clean equipment. Additionally, this was a single site study, so did not account for variations in equipment between hospitals. This study and scope were limited to the time it takes to clean and disinfect shared medical equipment,

and cannot be extrapolated to how long it takes to clean a patient's room.

In conclusion, cleaning and disinfection of shared medical equipment requires appropriate training and time. The time taken to clean and disinfect shared medical equipment is significant. The data from this study may be useful to help better inform resources required for cleaning, including the development of business cases and/or different models of service delivery to improve cleaning and disinfection of shared medical equipment. Findings can also be used in future cost-effectiveness evaluations related to cleaning.

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Conflict of interest statement
None declared.

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Author contributions
MK, BM and KB: conceptualization. GM and KB: data curation. GM and KB: formal analysis. BM: funding acquisition. BM, KB and GM: investigation. BM and KB: methodology. BM, KB and GM: project administration. BM: resources. BM: software. BM: supervision. BM, MK, PR, PT: validation. GM and KB: writing — original draft. GM, KB, BM, PT, PR and MK: writing — review and editing. This paper was written on behalf of the wider CLEEN [3,4] research team.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jhin.2024.08.001.

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