# National Survey of Environmental Cleaning and Disinfection in Hospitals in Thailand

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More than 90% of Thai hospitals surveyed reported implementing environmental cleaning and disinfection (ECD) protocols. Hospital epidemiologist presence was associated with the existence of an ECD checklist ($P = .01$) and of ECD auditing ($P = .001$), while good and excellent hospital administrative support were associated with better adherence to ECD protocols ($P < .001$) and ECD checklists ($P = .005$).

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Contaminated environmental surfaces in patient rooms are a critical component in healthcare-associated infection (HAI) transmission[1] and are a well-recognized cause of common-source nosocomial outbreaks.[2,3] Decontaminating hospital-room surfaces has emerged as a key target area to prevent the spread of HAI,[4,5] and it may help reduce the transmission of multidrug-resistant microorganisms (MDROs).[6] In the Asia Pacific region, a multinational guideline recommends the best practices in routine environmental cleaning and disinfection (ECD).[7] However, the extent to which the adoption of these practices to clean and disinfect the hospital environment as well as factors associated with adherence to ECD protocols in this region remain largely unknown. Therefore, we conducted a national survey to evaluate the ECD practices used among Thai hospitals, and we evaluated factors associated with implementing ECD policies and adherence to ECD practices.

## METHODS

From January 1, 2014, to November 30, 2014, we surveyed all hospitals in Thailand that had an intensive care unit (ICU) and at least 250 hospitals beds (n = 245). The list of included hospitals was obtained from Thai Ministry of Public Health. The survey instrument, first developed by Krein et al,[8] was translated into the Thai language by an experienced hospital epidemiologist (A.A.). The survey assessed general hospital, personnel, and infection control program characteristics, as well as the practices used by Thai hospitals to routinely clean and disinfect the hospital environment, including ECD practices. The survey included questions regarding whether facilities implemented protocols for ECD of patient care areas, the existence of checklists to monitor ECD practices, the use of ECD auditing, and adherence to ECD checklists and protocols. The lead infection preventionist (IP) for each hospital was interviewed to determine various hospital characteristics and to ascertain whether their hospital had implemented various ECD protocols. The level of adherence with ECD protocols was also assessed. Infection preventionists were asked how often the hospital complied with ECD practices (ie, 1 for 100% compliance to 6 for no monitoring compliance). Responses of 1 or 2 (ie, 75%–100% compliance) were coded as high compliance for all analyses. Hospital administration support was based on the response to the question, "How would you rank the overall support your infection control program receives from the hospital administrative leadership?" A Likert response scale was used: 1 for "poor" to 5 for "excellent." Responses of 3 "good" to 5 "excellent" represented strong support for the infection control program.

In-person interviews were administered by research nurses who used the survey instrument to interview each lead infection preventionist. In total, 3 training sessions were conducted to instruct the 5 research nurses on the survey and data collection procedures. The survey instrument was tested in a pilot study of 10 hospitals to ensure the validity, reliability, and acceptability of the survey results, and 100% agreement in the responses by the research nurses was observed in the pilot test. This study was approved by the Institutional Review Board of the Faculty of Medicine at Thammasat University.

Descriptive statistics were calculated for all relevant survey questions. Multivariable logistic regression was used to determine significant associations between hospital characteristics and regular use of each ECD practice. The hospital characteristics considered included type of ownership, number of intensive care unit beds, affiliation with a medical school, presence of hospitalists, involvement in a collaborative effort to reduce HAI, strong support of the infection control program by hospital leadership, presence of a hospital epidemiologist, total full-time equivalent of all infection preventionists, the presence of an infectious diseases specialist, environmental cleaning services provided, existence of a facilities maintenance department, and presence of a microbiology laboratory. All statistical analyses were performed using SAS version 9.4 software (SAS Institute, Cary, NC).

## RESULTS

Overall, 212 of 245 eligible hospitals (86.5%) responded to our survey. Of these 212 hospitals, 192 (90.6%) reported implementing an ECD protocol, 117 (55.2%) had an ECD checklist, and 92 (43.4%) had a mechanism to audit ECD practices. Among hospitals implementing an ECD protocol, high adherence to implemented ECD practices and to ECD checklists was documented in 109 of 192 hospitals (56.8%) and 67 of 117 hospitals (57.3%), respectively. Hospital characteristics, policies, and practices as well as barriers to implementing the ECD policy are summarized in Table 1.

Our multivariable regression analyses revealed that the presence of a hospital epidemiologist was associated with the presence of an ECD checklist (OR, 2.37; 95% CI, 1.25–4.51; $P = .01$) and the existence of ECD auditing (OR, 3.19; 95% CI, 1.66–6.12; $P = .001$) (Table 2). Good-to-excellent hospital administration support for the infection control program was associated with greater adherence to implemented ECD protocols (OR, 5.36; 95% CI, 2.64–10.89; $P < .001$) and to ECD checklists (OR, 3.71; 95% CI, 1.49–9.23; $P = .005$).

## DISCUSSION

A few key findings emerged from our national survey. First, while most Thai hospitals reported having ECD protocols and ECD auditing, adherence to ECD protocols and adherence to ECD checklists remained suboptimal. Second, we identified the significant roles of the hospital epidemiologist and strong administration support for an infection control program to enhance the adoption of ECD practices in this middle-income country. To our knowledge, this is the first national survey to investigate the policies and practices related to ECD in a country in the Asia Pacific region. Our findings help identify areas for improvement and can help inform appropriate strategies to improve ECD practices in this region.

Previous national surveys from the United States, Japan, and Thailand identified several factors associated with the adoption of numerous HAI preventive practices.[8–10] These factors include strong safety culture in the organization, participation in an HAI preventive effort, and good-to-excellent support from hospital leadership.[8–10] Similarly, in this study, good-to-excellent hospital administration support for the infection control program was associated with greater adherence to ECD protocols and to ECD checklists. Additionally, having a hospital epidemiologist was associated with presence of an ECD checklist as well as regular ECD auditing. This association may be explained in part by the curriculum created by the Thai government to provide formal training for postgraduate physicians in infection prevention to become hospital epidemiologists. This finding highlights an opportunity for other countries in Asia to provide formal training in hospital epidemiology through national and regional societies (eg, Asia Pacific Society of Infection Control) as part of strategic infection prevention plans to improve national and regional ECD practices.

This study has some limitations. First, because the response rate was less than 100%, our results are susceptible to non-response bias. Although we achieved a very high response rate, our findings may not be generalizable to all hospitals. Second, because we relied on self-reported data from the lead infection preventionist at each facility to determine the frequency of the various practices being used, there is a potential for respondent bias. Third, ECD practice compliance rates were reported by the lead infection preventionist and may not reflect actual compliance. Finally, we did not have access to (and thus could not adjust for) patient-level or hospital case-mix data. As such, our regression estimates could be biased because of unmeasured confounding, and our results can only be interpreted as providing evidence for associations rather than causal mechanisms.

In conclusion, we identified key strategies that Thai hospitals engaged in ECD practices should focus on. Garnering strong leadership support for infection prevention efforts and having a hospital epidemiologist on staff to champion the resources and buy-in necessary for a successful infection control program may help improve future ECD practices in Thailand.

TABLE 1. Hospital Characteristics, Policy, Practice, and Barriers to Implementing Environmental Cleaning/Disinfection (ECD) Policies

| Characteristics | No. (%)[a] |
|---|---|
| Type of ownership | |
| Private | 44 (20.8) |
| Government owned | 148 (69.8) |
| Military | 20 (9.4) |
| Total number of acute-care hospital beds (including ICU) | 545.9 ± 468.5 |
| Affiliated with medical school | 111 (52.4) |
| Facility has infectious diseases specialist(s) | 108 (50.9) |
| Facility has environmental health and safety/services | 130 (61.3) |
| Involved in HAI collaborative | 105 (49.5) |
| Overall support of infection control program is good/excellent | 135 (63.7) |
| Facility has hospital epidemiologist | 83 (39.2) |
| Total FTEs for all infection preventionists | 3.5 ± 3.4 |
| Lead infection preventionist certified in infection control | 196 (92.5) |
| How does your facility obtain environmental services? | |
| Internal employees | 65 (20.7) |
| Contract service with an external company | 40 (18.9) |
| Both internal employees and contract services | 105 (49.5) |
| Facility implements ECD protocol | 192 (90.6) |
| Facility has ECD checklist | 117 (55.2) |
| Facility has a mechanism to audit ECD practices | 92 (43.4) |
| Method used to audit ECD practices[a] | |
| ATP or bioluminescent testing | 9 (9.8) |
| Flourescent marking | 13 (14.1) |
| Microbiological monitoring | 52 (57.1) |
| Visual inspection for cleanliness | 60 (65.9) |
| Barrier for effectively implementing ECD protocol[b] | |
| Staffing concerns | 168 (79.3) |
| Time constraints | 124 (58.5) |
| Lack of resources or funding | 128 (60.4) |
| Facility culture | 139 (65.6) |
| Inadequate education provided to staff | 160 (75.5) |
| Uncertainty regarding which cleaning and disinfecting products to use | 121 (57.1) |

NOTE. HAI, healthcare-associated infection; ICU, intensive care unit; FTEs, full-time equivalents; ATP, adenosine triphosphate.

[a]Unless otherwise indicated.

[b]Respondents can respond with >1 answer. The sum of all methods used to audit ECD practices is >100%.

TABLE 2. Hospital Characteristics Associated With Implementing Environmental Cleaning and Disinfection (ECD) Policies and Adhering to ECD Practices

| | Facility has implemented a protocol for cleaning and disinfection of patient care areas | | Adherence to implemented protocol for cleaning and disinfection of patient care areas | | Checklist for proper cleaning and disinfecting patient care areas | | Adherence to checklist for proper cleaning and disinfecting patient care areas | | Facility performs cleaning audits, where level of contamination on a surface is checked regularly | |
|---|---|---|---|---|---|---|---|---|---|---|
| Characteristic | OR (95%CI) | p-value | OR (95%CI) | p-value | OR (95%CI) | p-value | OR (95%CI) | p-value | OR (95%CI) | p-value |
| Ownership | | | | | | | | | | |
| Government (reference) | - | - | - | - | - | - | - | - | - | - |
| Private | 2.26 (0.44–11.51) | 0.33 | 1.21 (0.49–3.01) | 0.68 | 1.49 (0.65–3.43) | 0.35 | 1.58 (0.45–5.48) | 0.47 | 0.70 (0.30–1.65) | 0.42 |
| Military | 1.33 (0.23–7.65) | 0.75 | 0.62 (0.19–2.04) | 0.43 | 0.61 (0.21–1.74) | 0.35 | 0.66 (0.11–3.87) | 0.64 | 2.20 (0.74–6.53) | 0.16 |
| ICU Beds | 1.00 (0.99–1.00) | 0.3 | 0.99 (0.98–1.00) | 0.05 | 1.01 (1.00–1.02) | 0.06 | 0.99 (0.98–1.00) | 0.03 | 1.00 (1.00–1.01) | 0.53 |
| Medical school affiliation | 0.76 (0.24–2.42) | 0.64 | 0.77 (0.35–1.71) | 0.52 | 0.40 (0.20–0.81) | 0.01 | 1.50 (0.48–4.70) | 0.49 | 0.76 (0.37–1.58) | 0.47 |
| Hospitalists | inestimable | - | 1.09 (0.18–6.78) | 0.93 | 0.26 (0.03–1.92) | 0.19 | 0.13 (0.01–1.82) | 0.13 | 0.43 (0.08–2.40) | 0.33 |
| Involved with HAI collaborative | 1.69 (0.56–5.06) | 0.35 | 0.70 (0.32–1.50) | 0.36 | 1.43 (0.73–2.80) | 0.3 | 0.98 (0.37–2.58) | 0.97 | 1.71 (0.87–3.37) | 0.12 |
| Overall support of infection control program | 1.11 (0.40–3.04) | 0.84 | 5.36 (2.64–10.89) | <0.001 | 0.87 (0.46–1.63) | 0.66 | 3.71 (1.49–9.23) | 0.005 | 1.69 (0.89–3.21) | 0.11 |
| Hospital epidemiologist | 1.23 (0.43–3.55) | 0.7 | 1.61 (0.80–3.25) | 0.19 | 2.37 (1.25–4.51) | 0.01 | 2.33 (0.94–5.78) | 0.07 | 3.19 (1.66–6.12) | 0.001 |
| Total full time equivalent of all infection preventionists | 1.08 (0.87–1.34) | 0.49 | 1.08 (0.95–1.22) | 0.27 | 1.02 (0.92–1.12) | 0.76 | 1.03 (0.90–1.18) | 0.64 | 0.87 (0.77–0.98) | 0.03 |
| Lead infection preventionist certified in infection control | 2.26 (0.50–10.29) | 0.29 | 0.61 (0.16–2.32) | 0.47 | 0.79 (0.25–2.43) | 0.68 | 0.64 (0.11–3.69) | 0.62 | 0.65 (0.20–2.12) | 0.47 |
| Infectious disease specialist | 0.55 (0.14–2.09) | 0.38 | 2.02 (0.82–4.93) | 0.12 | 1.01 (0.46–2.25) | 0.97 | 0.76 (0.20–2.83) | 0.68 | 1.41 (0.63–3.13) | 0.4 |
| Environmental cleaning services | 1.72 (0.47–6.32) | 0.41 | 1.28 (0.53–3.08) | 0.58 | 0.88 (0.40–1.95) | 0.76 | 2.13 (0.72–6.30) | 0.17 | 2.19 (0.97–4.97) | 0.06 |
| Facilities maintenance department | 0.87 (0.25–2.97) | 0.82 | 1.04 (0.47–2.29) | 0.93 | 1.40 (0.69–2.84) | 0.35 | 1.89 (0.65–5.52) | 0.24 | 1.15 (0.55–2.40) | 0.7 |
| Microbiology lab | 1.37 (0.13–14.97) | 0.79 | 6.08 (0.97–38.11) | 0.05 | 5.05 (0.78–32.51) | 0.09 | 4.25 (0.05–333.09) | 0.52 | 0.96 (0.20–4.54) | 0.95 |

NOTE. OR, odds ratio; CI, confidence interval, ICU, intensive care unit, HAI, hospital-associated infection.

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## REFERENCES

1. Datta R, Platt R, Yokoe DS, Huang SS. Environmental cleaning intervention and risk of acquiring multidrug-resistant organisms from prior room occupants. *Arch Intern Med* 2011;171:491–494.
2. Sehulster L, Chinn RY. Guidelines for environmental infection control in health-care facilities. Recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee (HICPAC). *MMWR Recomm Rep* 2003;52(RR-10):1–42.
3. Weber DJ, Anderson D, Rutala WA. The role of the surface environment in healthcare-associated infections. *Curr Opin Infect Dis* 2013;26:228–344.
4. Dettenkofer M, Wenzler S, Amthor S, Antes G, Motschall E, Daschner FD. Does disinfection of environmental surfaces influence healthcare associated infection rates? A systematic review. *Am J Infect Control* 2004;32:84–89.
5. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist in inanimate surfaces? A systematic review. *BMC Infect Dis* 2016;6:130.
6. Otter JA, Yezli S, French GL. The role played by contaminated surfaces in the transmission of nosocomial pathogens. *Infect Control Hosp Epidemiol* 2011;32:687–689.
7. Ling ML, Apisarnthanarak A, Thu le TA, Villanueva V, Pandjaitan C, Yusof MY. APSIC Guidelines for environmental cleaning and decontamination. *Antimicrob Resist Infect Control* 2015;4:58.
8. Apisarnthanarak A, Greene MT, Kennedy EH, Khawcharoenporn T, Krein S, Saint S. National survey of practices to prevent healthcare-associated infections in Thailand: the role of safety culture and collaboratives. *Infect Control Hosp Epidemiol* 2012;33:711–717.
9. Krein SL, Fowler KE, Ratz D, Meddings J, Saint S. Preventing device-associated infections in US hospitals: national surveys from 2005 to 2013. *BMJ Qual Saf* 2015;24:385–392.
10. Sakamoto F, Sakihama T, Saint S, Greene MT, Ratz D, Tokuda Y. Health care-associated infection prevention in Japan: the role of safety culture. *Am J Infect Control* 2014;42:888–893.