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REFERENCES

1. Rutala WA, Weber DJ, Healthcare Infection Control Practices Advisory Committee. Guideline for disinfection and sterilization in healthcare facilities, 2008. Centers for Disease Control and Prevention website. http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf. Accessed September 10, 2015.
2. Rutala WA, Weber DJ. Selection and use of disinfectants in healthcare. In Mayhall CG ed. *Hospital Epidemiology and Infection Control*, 4th ed. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins, 2012.
3. Kovaleva J, Peters FTM, van der Mei HC, Degener JE. Transmission of infection by flexible gastrointestinal endoscopy and bronchoscopy. *Clin Reviews Microbiol* 2013;26:231–253.
4. Wendelboe AM, Baumbach J, Blossom DB, Frank P, Srinivasan A, Sewell CM. Outbreak of cystoscopy-related infections with *Pseudomonas aeruginosa*: New Mexico, 2007. *J Urology* 2008;180:588–592.
5. Clemens JQ, Goldman H, Senese V, Bertsch J. Joint American Urological Association and Society of Urological Nurses and Associates white paper on reprocessing of flexible cystoscopies. American Urological Association website. https://www.auanet.org/common/pdf/education/clinical-guidance/Cystoscopy-WP.pdf. Accessed July 29, 2015.
6. Petersen BT, Chennat J, Cohen J, Cotton PB, Greenwald DA, Kowalski TE, Krinsky ML, Park WG, Pike IM, Romagnuolo J, Rutala WA. Multisociety guideline on reprocessing flexible GI endoscopes, 2011. *Infect Control Hosp Epidemiol* 2011;32:527–537.

A Cluster-Randomized Controlled Trial of the Catheter Reminder and Evaluation Program

Healthcare-associated infection (HAI) is considered a global health burden. Based on data from a recent US study, catheter-associated urinary tract infections (CAUTIs) and central-line–associated bloodstream infections (CLABSIs) are leading causes of HAI.[1] Similarly, CAUTIs, and CLABSIs are the leading causes of HAI in Thailand.[2]

Various infection control strategies and bundles have proven effective in preventing CAUTIs and CLABSIs.[2–5] However, most of these strategies require full-time infection control personnel, which may not be practical in resource-limited settings. Effective but less labor-intensive interventions to prevent HAIs are needed. In this study, we primarily aimed to determine the effectiveness of a simple and less labor-intensive intervention for reducing the duration of urinary catheter use and preventing CAUTIs.

During February–July 2013, an open-label cluster-randomized controlled trial was conducted at Siriraj Hospital, a 2,300-bed tertiary care hospital in Thailand. A total of 6 general medicine wards were randomly allocated to receive the usual infection control care either with or without the Catheter Reminder and Evaluation (CARE) program. The study was approved by Siriraj Institutional Review Board, which waived the subject's informed consent (ClinicalTrials.gov identifier: NCT01797146).

The usual infection control care includes universal precautions and cohorting of patients who are infected or colonized with a multidrug-resistant pathogen. The CARE program consists of 2 steps. The first step is performed by a ward nurse who evaluates each patient daily. If a given patient receives a urinary catheter or central venous catheter, his or her doctor's order sheet is marked with a CARE self-inking stamp (Supplementary Online Figure 1) indicating the first day of catheter use. The second step is performed by the responsible physician who documents an indication for catheter use during a service round in the morning. If an appropriate indication for catheter use is not written, the ward nurse reminds the responsible physician to do so. Both steps are repeated daily as long as the catheter is in place.

All necessary data were obtained from the hospital pharmacy database, the microbiology database, and patient medical records. Appropriateness of urinary catheter use was evaluated according to the Healthcare Infection Control Practices Advisory Committee guideline for prevention of CAUTIs.[6] Hierarchical model and clustering effect adjustment were used to evaluate the effectiveness of the CARE program. For all calculations, a 2-tailed $P < .05$ was considered statistically significant. All calculations were performed using the STATA/IC version 14.0 (Stata Corp, College Station, TX, USA).

We enrolled 433 patients into the CARE group and 441 patients into the control group. Mean ages of the CARE and control groups were comparable (61.5 ± 18.6 years vs 61.4 ± 17.9 years; $P = .93$). Approximately one-third of both groups had a history of previous hospitalization within the past 3 months. Baseline characteristics were comparable between the groups (as shown in Supplementary Online Table 1) except for history of organ transplantation, which was slightly lower in the CARE group (0.7% vs 2.5%; $P = .03$).

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TABLE 1. Outcomes of Interest

Outcomes of Interest	CARE (n = 433)	Control (n = 441)	Adjusted *P* Value[c]
Catheter days, mean ± SD			
All catheters, d[a]	6.9 ± 13.5	10.7 ± 41.4	.03
All temporary catheters, d[b]	6.8 ± 13.5	10.2 ± 40. 9	.02
All urinary catheters, d	5.1 ± 7.5	8.0 ± 38.5	.07
Foley's catheter, d	4.9 ± 7.4	7.5 ± 37.9	.04
Percutaneous nephrostomy, d	0.6 ± 0.7	0.4 ± 7.2	.23
Other urinary catheters, d	0.1 ± 0.9	0.2 ± 1.2	.66
Central venous catheter, d	1.9 ± 8.8	2.7 ± 14.6	.001
Hospital outcomes			
Median length of stay, d (range)	9 (1–354)	10 (1–304)	.03
Hospital mortality, No. (%)	85 (19.6)	80 (18.1)	.45
New episodes of healthcare-associated infections			
Cumulative incidence of CAUTIs, No. (%)	47 (10.9%)	40 (9.1%)	.13
Cumulative incidence of CLABSI, No. (%)	9 (2.1%)	13 (3.0%)	.41
Incidence of CAUTIs per 1,000 catheter days, mean ± SD	30.4 ± 81.9; (n = 250)	25.4 ± 79.1; (n = 244)	.42
Incidence of CLABSI per 1,000 catheter days, mean ± SD	18.6 ± 73.6; (n = 49)	16.6 ± 50.2; (n = 49)	.77

NOTE. CARE, catheter reminder and evaluation; CAUTIs, catheter-associated urinary tract infections; CLABSI, central line-associated bloodstream infection; SD, standard deviation.

[a]All catheters included both temporary and permanent urinary and central venous catheters.

[b]All temporary catheters included all temporary urinary catheters and temporary central venous catheters.

[c]*P* value adjusted for clustering effect (population-averaged models).

Overall, ward nurse compliance was 83%, whereas overall responsible physician compliance was only 74%. Furthermore, only 68% of responsible physicians gave the appropriate indication for retaining the catheter or decided to remove the catheter when there was no appropriate indication. The most common inappropriate indication of urinary catheter use was monitoring urine output in a non–critically ill patient. The overall program compliance of both groups did not decline over time (Supplementary Online Figure 2).

Table 1 shows the outcomes of interest. Mean duration of all catheter days in the CARE group was significantly shorter than in the control group (6.9 ± 13.5 vs 10.7 ± 41.4; $P = .03$). The CARE group had a significant shorter duration of temporary catheter days (6.8 ± 13.5 vs 10.2 ± 40.9; $P = .02$), Foley's catheter days (4.9 ± 7.4 vs 7.5 ± 37.9; $P = .04$), central venous catheter days (1.9 ± 8.8 vs 2.7 ± 14.6; $P = .001$), and median length of hospital stay (9 [1–354] vs 10 [1–304]; P = .03). However, the cumulative incidence (infection episode per hospitalization), incidence rate (infection episode per catheter day) of CAUTIs and CLABSIs and hospital mortality were comparable between the 2 groups.

Our study confirmed that this simple intervention is effective for reducing the duration of catheter use and shortening the length of hospital stay. However, we did not detect any significant impact on CAUTIs, CLABSIs, or hospital mortality. Our findings were different from a previous study, which showed that applying a reminder sticker on medical records could reduce CAUTIs.[7] These findings may be the result of a small sample size and an imbalance of unmeasured characteristics.

Program compliance was only 83% among ward nurses and 74% among responsible physicians. Surprisingly, compliance did not decline overtime. This finding may be a result of the simplicity of the program.

Our study had several strengths. While many studies evaluating infection control intervention used only simple pre- or post-study design, our study was a cluster-randomized controlled study using a hierarchical model. Second, our study collected all important characteristics and clinical outcomes, whereas many previous studies collected only aggregate data on catheter use and catheter-associated infections.[7,8]

This study has some potential limitations. First, it was conducted to evaluate a behavioral intervention, so we could not mask responsible physicians. Second, cluster randomization was necessary to avoid contaminating the intervention effect but may lead to an imbalance of characteristics. Third, in this study, wards were covered by rotating residents; therefore, it is possible that residents in the CARE ward may transfer their positive behavior when rotating to the control ward.

In conclusion, our study results confirm that this simple program could reduce the duration of temporary catheter use, urinary catheter use, and central venous catheter use, and that it could also shorten the length of hospital stay. This simple intervention is a promising alternative for resource-limited settings where sophisticated infection control bundles are not feasible.

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SUPPLEMENTARY MATERIAL

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/ice.2015.262

REFERENCES

1. Zimlichman E, Henderson D, Tamir O, et al. Health care-associated infections: a meta-analysis of costs and financial impact on the US health care system. *JAMA Intern Med* 2013;173:2039–2046.
2. Korbkitjaroen M, Vaithayapichet S, Kachintorn K, Jintanothaitavorn D, Wiruchkul N, Thamlikitkul V. Effectiveness of comprehensive implementation of individualized bundling infection control measures for prevention of health care-associated infections in general medical wards. *Am J Infect Control* 2011;39:471–476.
3. Weeks KR, Hsu YJ, Yang T, Sawyer M, Marsteller JA. Influence of a multifaceted intervention on central line days in intensive care units: results of a national multisite study. *Am J Infect Control* 2014;42:S197–S202.
4. Allen GB, Miller V, Nicholas C, et al. A multitiered strategy of simulation training, kit consolidation, and electronic documentation is associated with a reduction in central line-associated bloodstream infections. *Am J Infect Control* 2014;42:643–648.
5. Blot K, Bergs J, Vogelaers D, Blot S, Vandijck D. Prevention of central line-associated bloodstream infections through quality improvement interventions: a systematic review and meta-analysis. *Clin Infect Dis* 2014;59:96–105.
6. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA, Healthcare Infection Control Practices Advisory C. Guideline for prevention of catheter-associated urinary tract infections 2009. *Infect Control Hosp Epidemiol* 2010;31:319–326.
7. Bruminhent J, Keegan M, Lakhani A, Roberts IM, Passalacqua J. Effectiveness of a simple intervention for prevention of catheter-associated urinary tract infections in a community teaching hospital. *Am J Infect Control* 2010;38:689–693.
8. Apisarnthanarak A, Rutjanawech S, Wichansawakun S, et al. Initial inappropriate urinary catheters use in a tertiary-care center: incidence, risk factors, and outcomes. *Am J Infect Control* 2007;35:594–599.

Antibiotic Prescribing in Psychiatric Hospitals and Interactions between Antibiotics and Psychotropic Drugs: A Prospective Observational Study

Antibiotic consumption in psychiatric hospitals is low compared to general hospitals when the consumption is measured in defined daily doses (DDD) per 100 patient days. Measured in DDD per admission, however, the consumption of antibiotics in general and psychiatry hospitals may almost be the same.[1]

Antibiotics have several drug–drug interactions (DDIs) with psychotropic drugs that can lead to adverse events or treatment failure and significantly increase the costs of treatment. The safest drugs for psychiatric patients are penicillin, cephalosporin, aminoglycosides, and nitrofurantoin; macrolides and quinolones should be used with great caution.[2–4] Mortality and morbidity are increased in patients experiencing DDIs and inappropriate prescribing.[5]

Very little is known about antibiotic prescribing patterns in psychiatric hospitals, including the frequency of potential DDIs between antibiotics and psychotropic drugs.

All Slovenian psychiatric departments were invited to participate. One hospital did not respond. The study included only patients who were prescribed antibiotics in psychiatric hospitals within the study duration. Patients already undergoing antibiotic treatment prior to the study period were excluded. The study was conducted in two 14-day periods: the first in December 2012 and the second in May 2013. The study excluded patients with antibiotics prescribed before admission. Psychiatrists were in charge of diagnosing infections and prescribing antibiotics. All included patients were monitored throughout the whole course of antibiotic treatment. In each hospital, a dedicated person (psychiatrists and clinical pharmacist) collected the data using a survey form we sent to them.

The incidence of antibiotic prescriptions was expressed as the number of new antibiotic prescriptions per 100 admissions and the number of new antibiotic prescriptions per 100 bed days. The data regarding the number of admissions and bed days during the study periods was obtained from the hospitals' statistical services. The DDI software program Lexicomp 2012 (version 1.9.1; Lexi-Comp, Hudson, OH), was used to identify potential DDIs. Lexicomp categorizes each potential DDI according to clinical significance in 5 groups: X, D, C, B, and A. DDIs of level D and X were considered clinically significant and were included in this study. This study was approved by the National Medical Ethics Committee of the Republic of Slovenia in 2012.

A total of 74 patients met the inclusion criteria. The incidences of antibiotic prescriptions (expressed as the number of new antibiotic prescriptions per 100 admissions) were 12.9 per 100 admissions in December 2012, 7.58 per 100 admissions in May 2013, and 10.4 per 100 admissions in total. The incidences

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