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## Major article

## Design and analysis of a pharmacist-enhanced antimicrobial stewardship program in Thailand



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## Key Words:

Clinical pharmacist  
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**Background:** The purpose of this study was to design and evaluate the enhancement of an antibiotic stewardship program (ASP) with trained hospital-based infectious diseases clinical pharmacists (IDCPs). **Methods:** The IDCP training entailed a 12-hour course by 3 pharmacists. From January 1, 2012–September 30, 2012, all patients consecutively admitted with presumptive infections to 6 medicine units were prospectively followed to discharge. Standard of care (SoC) included ASP measures with or without infectious diseases consultations (IDCs). Physician teams had the option to request IDCs, IDCPs, or both. The IDCP support included pharmacist participation in daily rounds to inform on antibiotic use. Outcomes examined were inappropriate antibiotic use, antibiotic de-escalation, duration of antibiotic use, and hospital length of stay (LOS) stratified by patient groups who received SoC versus adjunctive IDCPs with and without IDCs.

**Results:** There were 150 patients in the SoC group, 104 in the IDCP group, and 320 in the IDCP plus IDC group. Most antibiotic prescriptions were for empirical therapy ( $n = 373$ , 65%), and the top-ranked indications were infections of the respiratory tract ( $n = 287$ , 50%) and urinary tract ( $n = 165$ , 29%). By multivariate analysis, compared with SoC, the 2 other groups were less likely to be prescribed inappropriate antibiotic use ( $P < .001$ ), had de-escalation of antibiotics ( $P < .001$ ), received antibiotics  $< 7$  days ( $P < .001$ ), and had subjects with shorter hospital LOSs ( $P < .001$ ). There were no group differences in mortality.

**Conclusion:** Our study suggests measurable treatment benefits associated with international IDCP training and the integration of adjunct IDCP services into hospital-based ASPs.

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Evidence-based recommendations exist for enhancement to antibiotic stewardship programs (ASPs) with trained infectious diseases clinical pharmacists (IDCPs).<sup>1-5</sup> These pharmacists provide advice on antibiotic drug use, dose, and drug-drug interactions; contribute to infectious diseases consultations (IDCs); and provide clinical support to continuing education programs for medical staff

and pharmacy students.<sup>1-5</sup> The addition of the IDCPs to IDCs has been associated with appropriate antibiotic use and reduction in mortality and adverse events.<sup>1-5</sup> In the United States, certification programs exist for IDCPs; however, such training is nonexistent in Thailand.<sup>6</sup> We designed and executed an IDCP training course and conducted a follow-up feasibility study to evaluate the integration and outcomes associated with adjunctive IDCP consultations.

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Conflicts of interest: None to report.

## METHODS

## Setting

Thammasart University Hospital (TUH) is a 650-bed tertiary care university hospital with 6 medicine wards in central Thailand. Each

ward was staffed with 1 attending physician, residents, interns, and medical students. The TUH ASP was initiated in July 2004 and included pharmacy and infection control initiatives; 3 full-time staff were resourced via the ASP.<sup>7</sup> TUH had no outpatient antibiotic program. Independent of the study, a drug utilization evaluation form was a standard tool for assessment of appropriate antibiotic use by the ASP team, and routine education was disseminated on appropriate antibiotic use, with evaluation and feedback to prescribers.<sup>7</sup> There were 3 infectious diseases physicians available for IDC during the study interval. Historically, most (88%) antibiotics are intravenous formulations; antibiotics were prescribed by attending physicians (18%), residents (37%), and interns (33%) or medical students (12%) directly under an attending physician's or resident's supervision.<sup>7,8</sup> At the initiation of this study, adjunctive IDCP consultation was available based on an attending physician's discretion.

#### Study definitions and data collection

Study inclusion criteria were restricted to subjects with only 1 antibiotic prescription event. Exclusion criteria were patients who had multiple antibiotic prescription events (defined as patient having >1 episode of infection after admission) and those who died within 24 hours of admission. Criteria used to define the need for antibiotic therapy were adopted from the current edition of *Mandell, Douglas and Bennett's Principles and Practice of Infectious Diseases*.<sup>9</sup> We used local hospital antibiotic guidelines from existing publications to measure the appropriateness of antibiotic use, with antibiotic appropriateness guidelines prepared by the antimicrobial management program committee.<sup>10</sup> The guidelines included a short description of all antibiotics available in the hospital pharmacy, together with the recommended dosage of each antibiotic, principles of antibiotic use for prophylaxis and treatment of infectious diseases, recommended antibiotics for prophylaxis, and recommended antibiotics for empirical and targeted therapy. The antibiotic guidelines were modified and agreed on by the faculty members in the clinical departments, the department of pharmacology, and the department of microbiology and were later approved by the faculty of medicine committee for hospitalized patients.

Specific categories for appropriate antibiotic use were modified from Kunin et al to fit local practices (Table 1).<sup>10</sup> Modifications were also made to accommodate susceptibility patterns and management of some infections specific to Southeast Asia, such as melioidosis. Antibiotic de-escalation encompassed the change from a broad to narrower spectrum of antibiotic coverage within 48 hours of available culture and susceptibility test results, along with discontinuation of antibiotic treatment if no pathogen was detected.<sup>11</sup> Inadequate antibiotic therapy included the absence of an antibiotic agent directed against the specific recovered pathogen or administration of antibiotic agents to which the pathogen attributed to the infection was resistant.<sup>11</sup>

#### Program design

At baseline, there was no structured IDCP training program. A training course for pharmacists was designed and executed to evaluate both the feasibility of this educational program and the outcomes associated with the integration of the adjunct IDCP into routine hospital-based care. Three doctor of pharmacy pharmacists who were not involved in the hospital ASP were enrolled in the adjunct IDCP protocol. From October 15, 2011-December 15, 2011, each IDCP completed six 2-hour infectious diseases training sessions. The curriculum included the following topics: (1) definition of appropriate antibiotic use, (2) common antibiotic drug

**Table 1**  
Categories of appropriate versus inappropriate antibiotic use

Category	Judgment
I	Agree with the use of antibiotic therapy; this prescription is appropriate
II	Agree with the use of antibiotic therapy; a potentially fatal bacterial infection cannot be ruled out
III	Agree with the use of antibiotic therapy, but a different (usually less expensive or less toxic) antibiotic is preferred
IV	Agree with the use of antibiotic therapy, but a modified dose or duration is recommended
V	Disagree with the use of antibiotic therapy; administration is unjustified

NOTE. Categories adapted from Kunin et al.<sup>10</sup> Categories I and II essentially indicated appropriate therapy, and categories III and IV indicated that there are some major deficiencies in the choice or use of antibiotic by the physician managing the problem and that antibiotic use is inappropriate.

interactions, (3) antibiotic de-escalation, (4) monitoring of antibiotic side-effects, (5) structure and organization of the ASP, (6) monitoring of outcomes by the ASP, and (7) examples of antibiotic use recommendations provided by an experienced infectious diseases physician. The pharmacists completed a pre- and post-test 20-item examination to assess baseline knowledge of antibiotic use. After the completion of the IDCP training program, adjunct IDCP consultation was made available hospital wide by means of department meetings, hospital letters, e-mail advertising to all attending physicians and house staff, and the TUH Intranet. The IDCP provided recommendations on antibiotic use to the team; however, they did not have prescribing privileges.

From January 1, 2012-September 30, 2012, all patients with infections admitted to 6 medicine units were prospectively followed to discharge. The 5 patient care outcomes were inappropriate antibiotic use, antibiotic de-escalation, duration of antibiotic use, hospital length of stay (LOS), and mortality. Patients were retrospectively partitioned into 3 groups: standard of care (SoC), IDCP, and IDCP plus IDC. After an IDCP consultation request, the IDCP was responsible for participation in daily rounds with the medical team, provision of advice on antibiotic use and potential adverse drug events, and reminders on antibiotic de-escalation. The IDCP did not make medical chart entries; standardized data collection was entered on a data collection form. Data collection included data on patient demographics, Acute Physiology and Chronic Health Evaluation II scores at the time of infection, underlying comorbidities, patterns of antibiotic prescriptions, infections associated with antibiotic prescription, and outcomes occurring after IDCP.

#### Statistical analysis

Analyses were performed using SPSS version 15 (SPSS, Chicago, IL). Categorical data were compared via  $\chi^2$  or Fisher exact test, as appropriate. Mann-Whitney *U* test was used to compare continuous variables. Logistic regression was performed to assess predictors for outcomes of interest, including appropriate antibiotic use, antibiotic de-escalation, duration of antibiotic use, and hospital LOS. Adjustment was made for key variables, including severity of illness, patient characteristics, and receipt of IDC and IDCP. Adjusted odd ratios (aORs) and 95% confidence intervals (CIs) were computed; a significant statistical difference was defined as  $P < .05$ .

## RESULTS

#### IDCP training course

There were 3 IDCP participants; the mean pretest score was 80% (range, 75%-85%), and the mean post-test score was 100% ( $n = 3$ ).

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