American Journal of Infection Control 41 (2013) 1069-72

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Impact of an antimicrobial stewardship program with multidisciplinary cooperation in a community public teaching hospital in Taiwan

Yu-Shiuan Lin MSc [a], I-Fen Lin DrPH [b,c], Yung-Feng Yen MD, MPH [b,d,e,*], Pei-Ching Lin MD [f,g], Yu-chih Shiu BSN [d], Hsing-Yi Hu BSN [d], Ying-Pi Yang MSc [a]

[a] Department of Pharmacy, Taipei City Hospital Yang-Ming Branch, Taipei City Government, Taipei, Taiwan
[b] Institute of Public Health, National Yang-Ming University, Taipei, Taiwan
[c] Biostatistical Consultation Centre, National Yang-Ming University, Taipei, Taiwan
[d] Committee of Infection Control, Taipei City Hospital Yang-Ming Branch, Taipei City Government, Taipei, Taiwan
[e] Department of Infectious Disease, Taipei City Hospital Yang-Ming Branch, Taipei City Government, Taipei, Taiwan
[f] Department of Clinical Pathology and Laboratory Medicine, Taipei City Hospital Yang-Ming Branch, Taipei City Government, Taipei, Taiwan
[g] Department of Pediatrics, Taipei City Hospital Yang-Ming Branch, Taipei City Government, Taipei, Taiwan

Key Words:
Program development
Education
Multidisciplinary
Clinical pharmacists
Feedback
Cost-benefit
Drug utilization evaluation

Background: Reports of antimicrobial stewardship programs (ASPs) in community hospitals are limited, with the major focus on specific agents, small settings, or short time periods. Here we present the outcomes of cost control, consumption restraint, and quality of care after a 3-year multidisciplinary ASP in a 415-bed community public teaching hospital.

Methods: Three strategies for improving antimicrobial stewardship were implemented: education, clinical pharmacists-based intervention, and regular outcome announcement. The steering panel of the program was a committee composed of infection specialists, attending physicians, clinical pharmacists, nurses, and medical laboratorists.

Results: Semiannual data from July 2009 to June 2012 was analyzed. Antibiotic costs declined from $21,464 to $12,146 per 1,000 patient-days (−43.4%). Approximately $2.5 million was saved in 3 years, and estimated labor cost was $3,935 per month. Defined daily dose per 1,000 patient-days were diminished from 906.7 to 717.5 (−20.9%). Significant reductions were found in the consumption of aminoglycosides, first-generation cephalosporins, and aminopenicillins. However, through comprehensive auditing, increasing consumption of fourth-generation cephalosporins and fluoroquinolones was noticed. No significant difference in the quality of care (ie, length of stay, incidence of health care associated infections, and mortality) was observed.

Conclusions: The multidisciplinary ASP was beneficial to reduce antibiotic cost and consumption. The strategies were practical and worthy to be recommended to community health care settings.

The utilization of antibiotic agents is of particular concern in hospitals. Substantial reports demonstrate the causal relationships among antibiotic consumption, selective pressure of resistant organisms,[1-3] adverse drug events, and health care costs.[4] This led to the wide application of antimicrobial stewardship programs (ASPs) in health care settings. Benefits of institutional ASPs to infection control, cost restraint, and improvement of quality of care—especially with an interdisciplinary cooperation—have been well presented.[5-8]

However, a recent survey conducted by the Infectious Disease Society of America Emerging Infections Network[9] noticed that ASPs were mostly in place in medical centers or university teaching hospitals. In Asian countries, most of the ASP reports were displayed by medical centers as well, demonstrating the efficacy of short-term intensive strategies,[10,11] specific antibiotic control,[12] or hospital-wide computerized antimicrobial approval programs.[13] Experience of community health care settings is limited, with the major focus on specific antimicrobial agents,[14] in small-sized institutions,[15] or over short time periods.[16,17] Comprehensive utilization analysis of antimicrobial agents is also insufficient. Given that the ASPs in community-based settings have gained attention in recent years,[18] we here provide our experience of ASP practice in a community public teaching hospital in Taipei, Taiwan.

* Address correspondence to Yung-Feng Yen, MD, MPH, Department of Infectious Disease, Taipei City Hospital Yang-Ming Branch, 105 Yu, Sheng St, Shi Lin District, Taipei City 111, Taiwan.
E-mail address: DAM37@tpech.gov.tw (Y.-F. Yen).

Conflicts of interest: None to report.

http://dx.doi.org/10.1016/j.ajic.2013.04.004

METHODS

Study designs

Taipei City Hospital Yang-Ming branch is a 415-bed, nonuniversity-affiliated community teaching hospital subordinate to the Taipei City Government. Taipei City Hospital Yang-Ming branch is active in community, geriatric, chest medicine, and long-term acute-care service. Unit drug dose dispensing with nominative delivery form is provided to all patients. During 2006-2008, cost of antibiotic agents was around $17-$19 per patient-day with an upward trend. It surged to $21 per patient-day during the first quarter of 2009. To increase the quality of antimicrobial prescriptions, as well as restrain the cost and consumption of antibiotic agents, an ASP was introduced in July 2009. The steering panel of this program was a committee of infection control composed of infection specialists, attending physicians, clinical pharmacists, infection control nurses, and medical laboratorists.

Intervention

The program was based on three components: provide systematic education on the stewardship concept, enhance pharmacists' participation in antimicrobial use evaluation, and report outcomes of the program regularly to all staff.

We provided systematic education to all staff, especially the prescribers, to enhance general adherence with the program. Semiannual plenary speeches were mainly on the rational use of antibiotics and infection control. In the forums, a 4-category control policy for antimicrobial prescribing was described: first-line antibiotics (includes antistaphylococcal penicillins, first-generation cephalosporins, and aminoglycosides) are used in clinical situations by all prescribers. Second-line antibiotics (such as aminopenicillines with enzyme inhibitors and second-generation cephalosporins) are prescribed according to the diagnosis (ICD-9 code) on the chart. For instance, amoxicillin/clavulanate is recommended for patients with community-acquired pneumonia according to the diagnosis (ICD-9 code 481) at admission. Third-line antibiotics are broad-spectrum agents such as antipseudomonal penicillins with enzyme inhibitors, third- and fourth-generation cephalosporins, and fluoroquinolones. Physicians are required to submit applications to the ASP steering panel through the health-care information system while prescribing. Fourth-line agents, namely imipenem, meropenem, colistin, linezolid, and tigecycline, are restricted to treat multiple drug-resistant organisms exclusively. Infection specialists will conduct a bedside evaluation before approving prescriptions online. However, to not impede treatment for severely ill patients, emergent antibiotic prescriptions for <1 day are available to instant dispensing.

To enhance pharmacists' participation in antimicrobial use evaluation, inappropriate selection of agents, dose, frequency, or duration of antimicrobials was reported by pharmacists via telephone calls upon the delivery of computerized prescriptions. Antimicrobial regimens were reevaluated weekly in general wards. Two clinical pharmacists joined ward rounds with infectious and intensive care medical teams 1-4 times a week, providing explicit therapeutic recommendations, especially in antibiotic use. Drug–drug interactions and adverse drug events were consulted as needed.

After the chief pharmacist submitted an analysis report to the committee of infection control during the quarterly meeting, it was presented to all staff, especially attending physicians, via the in-hospital Web site. Costs, consumption (defined daily dose [DDD]/1,000 patient-days), the percentage of antimicrobial agents in total drug costs, and a brief antimicrobial use evaluation were included. Use of controlled agents was monitored by retrospective chart review and sample survey. Potentially inappropriate prescriptions were discussed during the quarterly meeting, and directors of associated medical departments were informed, if needed.

Data analysis

To compare our data with international data, the expenditures related to medication were converted from New Taiwan dollars to US dollars at a ratio of 1:30.19. All values presented here are thus presented in US dollars. Unit price of medication kept steady except for a slight adjustment managed by the Bureau of National Health Insurance of Taiwan during December 2011. Consumption of antibiotics was translated by DDD according to the Anatomical, Therapeutic, and Chemical classification system/DDD system of the World Health Organization[19] and expressed as DDD/1,000 patient-days.

Quality indicators

To ensure the safety of this program, selective quality indicators were monitored by infection control nurses, including length of stay (LoS), patient mortality, incidence of health-care associated infections (HAIs) (defined as infections occurred >3 days after admission) and prevalence of health care-associated drug resistant organisms (HA-DROs). Target HA-DROs are namely oxacillin-resistant *Staphylococcus aerous*, *Escherichia coli* producing extended-spectrum β-lactamase, and pan-drug-resistant *Acinetobacter baumannii*,[20] which was cultured 3 days after admission.

Statistical analysis

Linear regression was used to examine the trend of semiannual antibiotics cost, DDD, LoS, mortality, incidence of HAIs, and HA-DROs before and after the program. Pearson's correlation coefficient was used to determine the relationship between the program implementation, and trends in antibiotic costs as well as consumption. A P value $\leq .05$ was considered statistically significant. Analyses were done with SPSS version 19.0 statistical software (IBM Corp, Armonk, NY).

RESULTS

During July 2009 through June 2012, there were 6 monitoring sessions, 12 panel meetings, and 6 education forums. Quarterly reports of antimicrobial use evaluation were presented by the chief pharmacist. There was no change in the antimicrobial categories under the controlling policy.

Cost savings after implementing the ASP

Cost of antibiotics during the study period is shown in Table 1. During the first half (H1) of 2009, mean cost of antimicrobials was $21,464/1,000 patient-days. 98.5% of the budget was spent for antibacterials. After 1 year of ASP practice, antibiotic cost per 1,000 patient-days was decreased remarkably (−25.8%), and we saved $607,140. The costs kept downgrading. In 2012 H1, the cost of antimicrobials reached the lowest point (−43.4%; $P = .02$). The percentage of expenses on antimicrobial agents to total medication declined as well. After the intervention, mean value of the proportions of antibiotic costs was 56.4% (−6.2% to −13.0%). Based on the expenditure records in 2009 H1, estimated financial preservation of the program was $2,495,954 in 3 years.