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The Impact of an Infectious Diseases Specialist-Directed Computerized Physician Order Entry Antimicrobial Stewardship Program Targeting Linezolid Use

To the Editor—The utilization of various antimicrobial stewardship program (ASP) strategies such as prior authorization, prescriber feedback and education, and antibiotic order forms have demonstrated favorable impacts on antibiotic utilization in academic settings.¹⁻⁴ To facilitate the implementation of ASPs, institutions have designed computer systems allowing physician/provider order entry (CPOE). CPOE allows direct entry of medical orders by authorized healthcare providers; this has the benefit of reducing errors by minimizing the ambiguity of handwritten orders, with greater benefits seen with the combination of CPOE and clinical decision support tools.⁵ In order to assess the potential impact of physician intervention on our community hospital-based, pharmacy-directed ASP, we undertook a prospective evaluation of li-

nezolid use following the addition of an infectious diseases (ID) physician to the program. The subsequent addition of a customized CPOE-ASP order entry template incorporating a linezolid decision algorithm provided an opportunity to monitor its potential additional impact over the subsequent 16 months.

In our 214-bed suburban nonacademic hospital, linezolid use was measured during a 32-month period from January 2008 to September 2010. The utilization formula combined a standardized defined daily dose (DDD) of 1,200 mg as recommended by the World Health Organization with hospital pharmacy purchasing data and hospital patient-days (PTD) to calculate a monthly DDD per 1,000 PTD.

Prior to implementation of the CPOE-ASP, a primary intervention consisting of ID physician educational activities represented the only new intervention that had the potential for impacting linezolid use. Shortly prior to implementation of the CPOE system, linezolid usage guidelines based on Food and Drug Administration–approved indications⁶ along with additional evidence-based recommendations approved by a local committee of clinical pharmacists and ID specialists were developed specifically for our CPOE system. Recommendations regarding alternative antibiotics with their dosages and rationale for use as well as hyperlinked references were included in the order entry form. All providers ordering antibiotics were identified and educated on the CPOE system and the antibiotic guidelines. In addition, a linezolid utilization audit was performed over two 5-month periods during the preintervention and CPOE-ASP periods by clinical pharmacists to determine whether linezolid orders reflected institution-approved indications.

The pharmacy provided information on the direct cost of linezolid during the periods studied. Baseline linezolid use over the 7 months prior to ID physician leadership involvement in the hospital's ASP averaged 44 DDD/1,000 PTD (Figure 1). Following ID physician involvement in the program and education of the medical staff, over a 9-month period linezolid use fell to 28 DDD/1,000 PTD ($P < .003$, Student *t* test). A further decrease to a mean of 7 DDD/1,000 PTD was realized and sustained over a subsequent 16-month period following CPOE implementation in the setting of ongoing physician involvement ($P < .001$ from baseline, Student *t* test). Examination of the proportion of nonappropriate linezolid use by the pharmacist-based audit confirmed a significant decrease in linezolid orders that deviated from institutional guidelines from 77% (26 of 34 orders) to 11% (1 of 13 orders; $P < .003$, Fisher exact test).

A review of the number of vancomycin-resistant enterococci (VRE) infections (based on VRE-positive cultures and the number of VRE-positive isolation rooms requested) demonstrated no changes during the study implementation. The length of stay for patients with skin/soft tissue infections was unchanged before and after CPOE implementation (data not shown). During the study there were no clear trends in overall

hospital length of stay, census, or patient mix. The overall cost of linezolid use over the 16 months after CPOE-ASP implementation resulted in a cost savings of more than \$638,000, compared to 16 months prior to CPOE-ASP implementation. If annualized on the basis of cost per month in a stable census setting, the savings at our hospital would have been approximately \$479,000 yearly.

Following the opening of our community hospital in 2005, linezolid use had become widespread and was substantially greater than the 1.5 DDD/1,000 PTD reported by Polk et al⁷ in 130 hospitals over a 12-month period in 2002–2003, prior to the increasing prevalence of VRE infections currently being seen. Although education decreased linezolid use to 28 DDD/1,000 PTD, the additional decrease in its use to 7 DDD/1,000 PTD was realized following the initiation of the CPOE-ASP. The decrease in linezolid use during the 32-month period of the study was not attributable to a decrease in the hospital census or patient mix. Furthermore, the decrease in linezolid use impacted neither the length of stay for patients with skin and soft tissue infections nor the incidence of VRE infections.

The threat of antimicrobial resistance has given rise to guidelines for the appropriate use of antibiotics.⁸ Although several studies have described the effectiveness of multi-antimicrobial ASPs that are pharmacist based^{1–4} and with CPOE systems utilizing clinical decision support tools,⁹ this report demonstrates the substantial savings that can be realized from optimizing the use of a single costly antibiotic. Given the substantial budgetary challenges in hospitals today, interventions such as ours have the potential for being used to enhance the feasibility of directing sustained administrative support for these types of programs. While limited to the experience of a single nonacademic community hospital, our findings support the benefits of a highly targeted intervention to optimize the utilization of a valuable antibiotic with substantial potential for overutilization.

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A Computer-Assisted Prescription System to Improve Antibacterial Surgical Prophylaxis

To the Editor—Growth of antibacterial resistance is a public health issue that was associated with antibiotic consumption.¹ Although not always easily implemented,² different strategies to improve patterns of antibacterial use in hospitals, including computer-assisted systems,³ have been suggested, and their effect in reducing antimicrobial resistance was reported.⁴

Hospital da Luz is a 4-year-old, paper-free, 190-bed private general hospital in Lisbon, Portugal. On January 1, 2011, a new computer-assisted prescription tool was implemented to improve antibacterial use patterns. The hospital's internal protocol for antibacterial surgical prophylaxis was introduced into the prescription tool. In surgical prophylaxis, prescribers are required to specify the antibacterial, the type of surgery, and the duration of the course (intraoperative, 24 hour, or 48 hour). When selection is not in accordance with the in-