

Evaluation of an Interactive Educational Model to Enhance Antimicrobial Stewardship at an Academic Medical Center

Kathryn E. DeSear^{1*}, Samuel Borgert¹, Aimée C. LeClaire¹, Kenneth Klinker¹, Kristin Weitzel² and Randy C. Hatton²

¹Infectious Diseases Pharmacy Resident, UF Health Shands Hospital, 1600 SW Archer Road, PO Box 100316, Gainesville, FL 32610-0316, USA

²University of Florida College of Pharmacy, 1600 SW Archer Road, PO Box 100486, Gainesville, FL 32610-0486, USA

*Corresponding author: Kathryn E. DeSear, PharmD, BCPS, AAHVP, Infectious Diseases Pharmacy Resident, UF Health Shands Hospital, 1600 SW Archer Road, PO Box 100316, Gainesville, FL 32610-0316, USA, Tel: (941) 773-7525; E-mail: Kathryn.desear@gmail.com

Rec date: Feb 02, 2015, Acc date: Feb 12, 2015, Pub date: Feb 22, 2015

Copyright: © 2015 DeSear KE, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Purpose: Employee education and professional development within a pharmacy department is vital for increasing job satisfaction and optimizing quantity and quality of interventions. Frontline pharmacists have a unique opportunity to intervene at the time of verification to prevent initiation of inappropriate antibiotics, avoid adverse reactions and toxicities from unnecessary agents, decrease risk for secondary infections, and lower selection pressure for antimicrobial resistance.

Methods: In an attempt to strengthen knowledge surrounding Antimicrobial Stewardship Program (ASP) practices at an academic medical center, an IRB-approved, prospective, non-randomized pilot educational program focused on urinary tract infections (UTIs) was developed for frontline pharmacy personnel with order verification duties. The goal of this program was to provide an interactive, case-based learning experience for pharmacists to improve their ability to make interventions on antimicrobials prescribed for UTI.

Results: Over half of pharmacists surveyed felt a lack of knowledge prohibited them from making interventions on UTI antimicrobials. Eighty-three percent of pharmacists desired to learn more about UTI treatment. After the CE lecture, pharmacists had a better perception of knowledge with significantly increased confidence and satisfaction in their understanding of UTI. Test scores assessing pharmacists' ability to make an intervention regarding appropriate antimicrobial treatment of UTI nearly doubled. Scores also significantly increased in pathogenesis and overall categories.

Conclusion: An interactive educational program focused on practical areas for intervention increased knowledge and confidence of frontline pharmacists. Involvement of these pharmacists extends the ASP footprint within our healthcare system.

Keywords: Education; Antimicrobial stewardship; Pharmacy practice

Background

The need for appropriate antibiotic use continues to be of global importance. With increasing resistance rates and a lack of novel antimicrobial agents in the drug development pipeline, the need for enhanced antimicrobial stewardship activities has been recognized by several national agencies and professional societies. Recent publications released from Centers for Disease Control and Prevention (CDC) and World Health Organization (WHO) warn of an apocalyptic-like reality in which common infections kill [1,2]. The CDC, Food and Drug Administration (FDA), and the National Institutes of Health (NIH) have partnered in the US and with the European Union to improve antimicrobial use and development through various intercontinental taskforces [3,4].

Institutions worldwide have recognized the need for Antimicrobial Stewardship Programs (ASP), leading to national campaigns to decrease inappropriate antimicrobial prescribing [5-10]. However, despite these extensive efforts, it is estimated that 50% of antimicrobials are prescribed inappropriately [11]. To enhance

healthcare professional involvement with stewardship initiatives, Society for Healthcare Epidemiology of America (SHEA) in collaboration with Infectious Diseases Society of America (IDSA), published guidelines on effective components of an ASP [10]. Recommendations centered on implementing a proactive process in which effective healthcare provider communication served as the crux of the intervention. With assistance from computerized surveillance, these measures have been associated with a reduction in antimicrobial initiation and duration of therapy [12]. Restrictive measures are also outlined and have a significant impact on inappropriate antimicrobial use [13]. Beyond a proactive ASP, clinical pathway development, incorporating national guidelines into local practice and education are emphasized [10].

Methods

In an attempt to strengthen knowledge surrounding ASP practices at an academic medical center, an Institutional Review Board (IRB)-approved, prospective, non-randomized pilot educational program focusing on urinary tract infections (UTI) was provided to frontline pharmacists. There were three phases incorporated in this study: 1) pre-education survey and test; 2) American Council for Pharmacy

Education (ACPE) accredited educational lecture; 3) post-education survey and test (Figure 1). A previously validated survey used to assess the impact of online physician continuing education programs utilizing a 5-point Likert scale (strongly agree, agree, neutral, disagree, strongly disagree) [14], was modified and administered to all participants to determine their perceptions of educational needs and confidence/satisfaction with their knowledge and ability to make interventions. The post-educational survey repeated these questions and also allowed for feedback on the educational process.

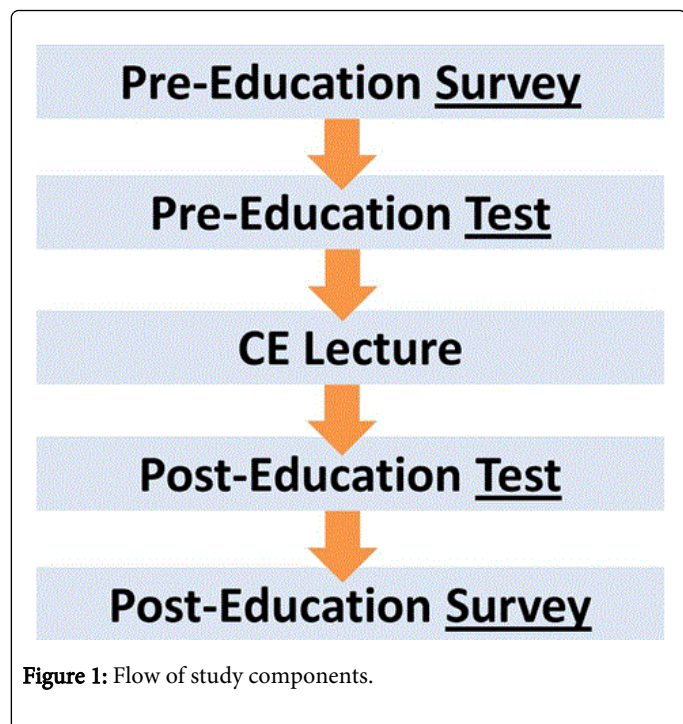


Figure 1: Flow of study components.

Mandatory tests comprised of 22 questions based on 7 de-identified patient case scenarios were administered to participants before and after the educational intervention. Test questions were not identical on pre- and post-tests; instead, questions assessed pre-specified clinical scenarios and were stratified between pre- and post-tests by category and cognition level. Clinical scenarios included catheterized and uncatheterized patients with asymptomatic bacteriuria, candiduria, and urinary tract infection. Bloom’s taxonomy was used to distribute questions among pathogenesis (9%), diagnosis (18%), classification (18%), and treatment (55%) categories, with the majority of questions occurring in the latter category since pharmacists’ primary role during order verification is to verify treatment decisions. Bloom’s taxonomy was also applied to cognitive level, with a focus on application (55%) since pharmacists were asked to apply their knowledge with real-time interventions. Other levels of cognition included comprehension (18%) and knowledge (27%).

The educational intervention consisted of a mandatory lecture providing 1 hour of ACPE-accredited Continuing Pharmacist Education (CPE) credit as live or recorded sessions to accommodate varied participant learning styles and schedules. The lecture was structured using patient cases contained within the pre-education test. Patient cases were analyzed with newly created original diagnostic and treatment algorithms for catheterized and uncatheterized patients with bacteriuria or candiduria. The algorithms were applied to each case with didactic lecturing detailing components of the decision-making

process. A website hosting these algorithms, as well as other helpful material pertaining to infectious diseases (ID), was created to enable a more interactive and durable process.

Descriptive statistics were reported for participation throughout the study period. Test scores and survey answers were analyzed with an F-test for homogeneity of variance and then compared with Student’s t-test (assuming equal or unequal variances based on the F test results) using Microsoft Excel (Redmond, Washington). A p value of <0.05 was considered significant.

Results

All pharmacists with medication order verification duties in the department of pharmacy were included in this study (n=72). Their demographics are shown in (Table 1). Participation in the pre- and post-education phases of the process was satisfactory, with 72% and 82% participation, respectively. Out of the 72 available pharmacists, 58 watched the lecture (36% live, 64% recorded). Overall, 61% of pharmacists completed all three phases of the study, with the remainder missing at least one component. Seven percent of pharmacists failed to complete at least one component of the study.

Baseline demographics	% (n)
Gender	
Male	41% (29)
Age	
40 years or less	59% (41)
Over 40 years	41% (29)
Years with Pharmacy License	
10 or less	56% (39)
Over 10	44% (31)
Primary practice site	
General medicine	33% (23)
Other	31% (22)
Critical care	19% (13)
Pediatrics	14% (10)
Administration	3% (2)

Table 1: Baseline demographics of pharmacists.

Results from the pre-education survey showed more than half of pharmacists surveyed felt a lack of knowledge prohibited them from making interventions on antimicrobials for UTI. Eighty-three percent of pharmacists desired to learn more about UTI treatment. After the CE lecture, pharmacists had a better perception of knowledge with significantly increased confidence and satisfaction in their understanding of UTI (Table 2). After completing the process, pharmacists were asked to give feedback on the project. Sixty-nine percent answered they learned something new from this process and 73% expect to use this information to avoid unnecessary/inappropriate treatment and/or diagnostic procedures in the future.

Test scores assessing pharmacists' ability to make an intervention regarding appropriate antimicrobial treatment of UTI nearly doubled after the educational lecture (Table 2). Scores also significantly increased in pathogenesis and overall categories. Test scores in the diagnostics category actually declined after the educational lecture. This was thought to be due to a more complicated case on the post-

test, focused on a catheterized patient with candiduria. Individual question analysis in each of the 2 diagnostic questions on the post-test revealed a bias in distribution of incorrect answers, with a significant majority choosing a single incorrect answer as opposed to equal distribution over the 3 incorrect distractor answers.

	Pre-education questions answered	Pre-Education average (n)	Post-education questions answered	Post-education average (n)	p value
Survey Results					
Satisfaction with Knowledge	70	30%	50	60%	<0.005
Confidence in Knowledge	68	26%	50	58%	<0.005
Test Results					
Classification	144	78%	124	72%	0.259418
Diagnostics	145	65%	128	49%	0.009
Pathogenesis	74	62%	64	89%	<0.005
Treatment	433	45%	378	86%	<0.005
Overall	796	56%	694	77%	<0.005

Table 2: Results.

Discussion

Concurrent with pathway development, ASP guidelines recommend education to enhance exposure to the process change [10]. However, developing sustainable high-quality educational programs that result in behavior change is challenging. Barriers include lack of clarity on optimal methods for delivering education to health care professionals; difficulty in measuring its utility; and challenges stemming from the constant flux of trainees rotating through an academic teaching hospital. Education without an active intervention has proven to be ineffective and ephemeral with most intervention studies failing to demonstrate a lasting effect [10,12,15]. However, education supplemented with an active intervention, such as an order form or clinical pathway, has contributed to reductions in antimicrobial consumption and resistance [16,17] and performance of physicians [18]. Extrapolation of these outcomes to pharmacist interventions may not be a fair comparison, but it is doubtful that education without intervention will promote practice changes.

Educational interventions are essential to develop and improve professional competence, defined by the Council on Credentialing in Pharmacy (CPP) as “good problem-solving and decision-making abilities, a strong knowledge base, and the ability to apply knowledge and experiences to diverse patient-care situations.” [19]. The American Society of Health-System Pharmacists (ASHP) specifies competence as the most fundamental moral responsibility of pharmacists, placing importance on CPE to guarantee optimal quality of care [20]. There are distinct competencies that must be mastered by a pharmacist specializing in infectious diseases [21], but not necessarily a pharmacist without formal post-graduate training. An American College of Clinical Pharmacy (ACCP) White Paper includes several skills (“select optimal drug, dose, route, frequency, and duration of therapy”), and specifically lists urinary tract infections (among other infectious diseases) as an area where competency must be maintained [22].

Additionally, employee education and professional development are important within a pharmacy department, both to increase job satisfaction and quantity and quality of interventions [23]. Pharmacists responsible for processing medication orders have a unique opportunity to intervene at the time of verification, to prevent initiation of inappropriate antibiotics, avoid adverse reactions and toxicities from unnecessary agents, decrease risk for secondary infections [24], and lower selection pressure for antimicrobial resistance [1]. In contrast to prospective audit initiatives in which clinical pharmacists are tasked with making selected interventions based on medications initiated several days prior, frontline pharmacists can deliver prescriber feedback at an earlier time point and concurrent with patient evaluation. Pharmacists may be met with less skepticism by providing timely interventions versus a request for therapy alteration in a patient who has improved on their current therapy. Therefore, developing initiatives centered on pharmacist education in conjunction with treatment algorithms and interactive tools may assist with improving interventions of frontline pharmacists.

Traditional CE lecture methods have shown to be less effective than interactive learning sessions [25]. Practice-based learning educational strategies engage the healthcare provider, encouraging a more interactive process with improved performance [18,26]. Therefore, our model of education included the development of an electronic website specifically housing ID information, including treatment algorithms created for UTI diagnostics and pharmacotherapy. We believe this product enhances our educational process by providing interactive resources with encouragement for user feedback. Also, the education and testing process incorporated into this analysis utilized test questions centered on key activities pharmacists realistically encounter to address stewardship opportunities for real world scenarios. Therefore, the aim of the lecture was to explain each branch within the UTI decision tree and provide pharmacists tools for increasing their involvement in stewardship initiatives.

Following data analysis, several areas for improvement were identified. First, future endeavors should include rapid access to pre- and post-test scores. Due to IRB-mandated blinding and interest in preventing answer sharing, pharmacists were unable to see their scores following completion of testing. This resulted in global scoring and delayed dissemination of explanations for correct answers. Pharmacists consistently provided feedback that this hindered their ability to learn from the process. In the future, educational efforts will incorporate direct and timely feedback. Second, education is an area of stewardship often criticized as ephemeral. Due to time constraints, persistence of educational effect was unable to be assessed. In effort to avoid repetition of identical test questions on the pre- and post-test, unique case scenarios were presented on the respective tests, possibly introducing bias if test questions were not equally difficult. We attempted to control for this using Bloom's taxonomy to distribute question categories and levels of cognition; and by analyzing responses. Although a website was employed to enhance the interactive nature of the educational effort, there was no way of tracking the number of visits to the website, so it is impossible to directly correlate the results to this component. An addition of an attendance tracker to the website would allow a more thorough correlation to study outcomes. Finally, the outcomes of the study were mainly subjective. Ability to make an intervention was assessed from the individual pharmacist's perspective. Intervention documentation is not tracked at this facility as a metric of productivity. Quantitative intervention tracking would increase our objective capacity to assess the value of the intervention.

UTI was chosen as the focus of education in this pilot study due to its potential for pharmacist involvement and clear evidence for differentiating between an active infection and colonization. With improvements in electronic medical records and development of treatment decision tools, frontline pharmacists have the capability to expand their clinical roles. Empowering these frontline pharmacists provides an opportunity to improve pharmacist-led interventions. Similarly designed studies have shown benefit of ID-focused education targeted towards frontline pharmacists in a community hospital where resources limit the ability to have a formally-trained ID pharmacist on staff to intervene on antimicrobial orders [27]. Even though academic teaching facilities often have the luxury of formally trained ID specialists, our study shows the benefit of educating frontline pharmacists to extend our reach and include more thorough and consistent patient-review. After completion of this study, educational efforts continued within the pharmacy department including incorporation of monthly huddles. At these meetings, clinical ID specialists discuss pertinent disease management strategies and disseminate clinical pearls to frontline pharmacists.

Conclusion

With an increasing awareness and push for more effective stewardship initiatives in the hospital setting, we have made continuous strides to improve the process. If left to a few select highly trained individuals, the success of the program is directly limited by their capacity to review patients and drug utilization from a global perspective. With the involvement of all responsible parties, including frontline pharmacists, we are able to cover more ground in our effort to improve antimicrobial utilization in our healthcare system.

Educational programs focused on practical areas for intervention by pharmacists with verification duties increase the knowledge and confidence of pharmacy personnel, possibly leading to improved

interventions. Enhancing educational processes by using supportive tools, such as algorithms and online materials, may increase proactive responses in patients prescribed antimicrobials, which has been shown to improve the impact of educational efforts [18]. Overall, by involving frontline pharmacists in ASP, we extend our footprint within the healthcare system.

References

1. Antibiotic resistance threats in the United States (2013) US Department of Health and Human Services and Centers for Disease Control and Prevention: 5-92.
2. World Health Organization (2014) Antimicrobial resistance: global report on surveillance, Geneva: IX.
3. Interagency Task Force on Antimicrobial Resistance (2011) A public health action plan to combat antimicrobial resistance.
4. Cole J (2012) Antimicrobial resistance, infection control and planning for pandemics: the importance of knowledge transfer in healthcare resilience and emergency planning. *J Bus Contin Emer Plan* 6: 122-135.
5. Huttner B, Harbarth S (2009) "Antibiotics are not automatic anymore"--the French national campaign to cut antibiotic overuse. *PLoS Med* 6: e1000080.
6. Buckley H (2003) Clinical brief: severe acute respiratory syndrome (SARS). *AAOHN J* 51: 303-305.
7. Society for Healthcare Epidemiology of America Infectious; Diseases Society of America; Pediatric Infectious Diseases Society (2012) Policy statement on antimicrobial stewardship by the Society for Healthcare Epidemiology of America (SHEA), the Infectious Diseases Society of America (IDSA), and the Pediatric Infectious Diseases Society (PIDS). *Infect Control Hosp Epidemiol* 33: 322-327.
8. ASHP Report (2010) ASHP statement on the pharmacist's role in antimicrobial stewardship and infection prevention and control. *Am J Health Syst Pharm* 67: 575-577.
9. Alliance for Prudent Use of Antibiotics (APUA).
10. Dellit TH, Owens RC, McGowan JE, Dale NG, Robert AW, et al. (2007) Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 44: 159-177.
11. Fishman N (2006) Antimicrobial stewardship. *Am J Med* 119: S53-61.
12. Solomon DH, Van Houten L, Glynn RJ, Baden L, Curtis K, et al. (2001) Academic detailing to improve use of broad-spectrum antibiotics at an academic medical center. *Arch Intern Med* 161: 1897-1902.
13. Davey P, Brown E, Fenelon L (2005) Interventions to improve antibiotic prescribing practices for hospital inpatients (Review). *Cochrane Database of Systematic Reviews* 4: CD003543.
14. Information Technology Primary Care Research Group. The Information Assessment Method. Department of Family Medicine, McGill University.
15. Jacob JT, Gaynes RP (2010) Emerging trends in antibiotic use in US hospitals: quality, quantification and stewardship. *Expert Rev Anti Infect Ther* 8: 893-902.
16. Bantar C, Sartori B, Vesco E, Claudia Heft, Mariano Sau, et al. (2003) A hospitalwide intervention program to optimize the quality of antibiotic use: impact on prescribing practice, antibiotic consumption, cost savings, and bacterial resistance. *Clin Infect Dis* 37: 180-186.
17. Gyssens IC, Blok WL, van den Broek PJ, Hekster YA, van der Meer JWM, et al. (1997) Implementation of an educational program and an antibiotic order form to optimize quality of antimicrobial drug use in a department of internal medicine. *Eur J Clin Microbiol Infect Dis* 16: 904-912.
18. Davis DA, Thomson MA, Oxman AD, Haynes RB (1992) Evidence for the effectiveness of CME. A review of 50 randomized controlled trials. *JAMA* 268: 1111-1117.

19. Council on Credentialing in Pharmacy (2001) Credentialing in pharmacy. The Council on Credentialing in Pharmacy. *Am J Health Syst Pharm* 58: 69-76.
20. American Society of Hospital Pharmacists (1990) ASHP statement on continuing education. *Am J Hosp Pharm* 47: 1855.
21. Ernst EJ, Klepser mE, Bosso JA, Michael JR, Elizabeth DH, et al. (2009) Recommendations for training and certification for pharmacists practicing, mentoring, and educating in infectious diseases pharmacotherapy. *Pharmacotherapy* 29: 482-488.
22. American College of Clinical Pharmacy, Burke JM, Miller WA, Spencer AP, Crank CW, et al. (2008) Clinical pharmacist competencies. *Pharmacotherapy* 28: 806-815.
23. 2011 employee job satisfaction and engagement. *Society for Human Resource Management*: 10-11.
24. Cohen SH, Gerding DN, Johnson S, Ciaran PK, Vivian GL, et al. (2010) Clinical practice guidelines for *Clostridium difficile* infection in adults: 2010 update by the society for healthcare epidemiology of America (SHEA) and the infectious diseases society of America (IDSA). *Infect Control Hosp Epidemiol* 31: 431.
25. McConnnell KJ, Newlon CL, Delate T (2010) The impact of continuing professional development versus traditional continuing pharmacy education on pharmacy practice. *The Annals of Pharmacotherapy* 44: 1585-1595.
26. Rouse MJ (2004) Continuing professional development in pharmacy. *Am J Health Syst Pharm* 61: 2069-2076.
27. Crader MF (2014) Development of antimicrobial competencies and training for staff hospital pharmacists. *Hosp Pharm* 49: 32-40.

This article was originally published in a special issue, entitled: "**Innovations in Pharmacy Education and Pharmacy Practiice**", Edited by $\{\$pIIssueAuthor\}$