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Research Note

Impact of an infectious diseases advanced pharmacy practice experience on student knowledge

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ABSTRACT

Introduction: The goal of this assessment was to determine knowledge acquisition by pharmacy students during an infectious diseases (ID) advanced pharmacy practice experience (APPE).

Methods: A 50-question knowledge-based examination was given to every student on a five-week ID APPE between July 1, 2013 and May 5, 2017. The examination was also given to control students (those who did not have an ID APPE) immediately prior to graduation. The primary outcome was difference in examination performance after completion of the ID APPE. Secondary outcomes included correlations between examination performance and number of previous inpatient clinical rotations (ICR), average score in therapeutic coursework (TC), and rotation block (RB).

Results: Forty students were included (control = 5, experimental = 35). Average pre-test scores were similar between experimental and control students [61.7 (10.9)% versus 62.0 (5.1)%, respectively], but experimental post-test scores [80.2 (7.9)%] were significantly better than pre-test scores for both experimental ($p < .05$) and control student ($p < .05$) examination scores. ICR [1.3 (1.0) rotations], TC [81.5 (3.9)%], and RB (median = 4) had a positive correlation with pre-examination performance ($R = .5, .5, \text{ and } .4$, respectively).

Discussion: Improved ID pharmacotherapy knowledge is needed. Baseline scores of students taking an ID elective were similar to control students who completed the entire year of APPEs, and knowledge scores were higher in ID students after APPE completion. There was a positive, but not strong, correlation between pre-examination performance and number of previous rotations, therapeutic coursework, and rotation block.

Conclusion: A five-week ID elective APPE improved student performance on a knowledge-based examination. Consideration should be given to more consistent integration of ID principles across all rotation types.

Introduction

Antimicrobial resistance is an ever-present threat to the optimal management of the infected patient. It is estimated that up to 10 million people will die annually from antibiotic resistant infections by 2050.¹ Numerous analyses have demonstrated a link between antimicrobial resistance and inappropriate therapy in worsening patient outcomes and expediting antimicrobial resistance emergence.² Similarly, reductions in antimicrobial use were linked to reductions in multidrug-resistant organism transmission.³ The Joint Commission recently announced new medication management standards targeting antimicrobial stewardship in institutions.⁴ Similarly, the Centers for Disease Control and Prevention published core elements of outpatient antimicrobial stewardship.⁵ Central to

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the success of these programs is a keen knowledge of infectious diseases and antimicrobial pharmacotherapy principles. Additionally, achieving and surpassing these goals can only be accomplished in multidisciplinary teams.

To best accomplish the task of broad, healthcare-wide antimicrobial stewardship, education must be provided during the course of the professional curriculum. Surveys of both medicine and pharmacy students have demonstrated that these two groups are aware of the threat that antimicrobial resistance and inappropriate antimicrobial use pose, but are uncomfortable in their knowledge of the topic.^{6,7} Significant variations were seen in student knowledge scores and were shown to be dependent on experiential education, school attended, and other measures of student-specific motivation and resourcefulness.⁷ Moreover, medicine and pharmacy students alike felt that stronger and more consistent curricular integration of infectious diseases principles was warranted. In the absence of curricular overhaul, one opportunity for intensive integration is infectious diseases (ID) advanced pharmacy practice experiences (APPEs). During these experiences, students are immersed in the practice of ID and must balance and analyze numerous clinical scenarios, many of which are new to the students. Knowledge acquisition by medical students and residents during a medical ID clerkship has been demonstrated to improve; however, the degree of knowledge acquisition during pharmacy clerkships has not been assessed to date.⁸

The recent reports from the Infectious Diseases Society of America reveal a lack of ID education options across disciplines⁹; therefore, the goal of this assessment was to determine the degree of knowledge acquisition by pharmacy students during a five-week adult ID APPE.

Methods

This study was an institutional review board approved single-center, quasi-experimental study with a pre-/post-test design. Students assigned to an ID elective APPE between July 1, 2013 and May 5, 2017 rounded with the adult ID consult service at a Level I trauma center and academic medical center. A 50-question pre- and post-rotation multiple-choice examination was given to every student on this five-week APPE on the first and last days of rotation. Questions were entirely knowledge-based, including concepts such as mechanisms of action, pharmacokinetic or pharmacodynamic principles, drug interactions, preferred or guideline-based treatments, and therapeutic or adverse event monitoring parameters.

Students on the ID rotation were integrated into the adult ID consult service. The ID consult team followed approximately 15–40 patients at any given time, with an average daily census of 20 patients. Disease states experienced varied widely from month to month, but generally included infections related to most of the body systems. Students were responsible for working up assigned patients daily, and experiences were supplemented with patient-related pharmacotherapy discussions. Students were not taught to the test.

The examination was also given to control students (those who did not have an ID APPE) immediately prior to graduation. Control students were recruited as a convenience sample of those with alternative rotations at the same site. The pre- and post-examinations were graded by the same preceptor for consistency, and allowances were made for updated or changed information as time progressed (e.g., two answers accepted based on new data).

The primary outcome was the difference in pre- and post-ID APPE examination performance. Secondary outcomes included correlations between examination performance and number of previous inpatient clinical rotations, average score in therapeutic coursework, and rotation block. Inpatient clinical rotations (ICRs) were defined as rotations in an inpatient setting that involved working up and presenting patients to preceptors and/or rounding on an inpatient multi-disciplinary team. Number of ICRs was counted from the student curriculum vitae provided at the beginning of the ID rotation. Therapeutic coursework (TC) included grades from multiple-choice examinations in a pharmacotherapeutic course during the third professional year. This course was entirely student-led, in a problem-based learning format. It included case-based discussions covering all disciplines, and represented the entirety of the therapeutics coursework in this curriculum. Examination scores from the entire year were weighted according to amount of material covered and averaged into a final TC score that was used for comparison. Rotation block (RB) was defined based on the five-week period/time of the year that the student had the ID rotation (e.g., block 1 = June–July, block 2 = July–August). Descriptive statistics [mean (standard deviation)] were used for examination results and TC. Two-tailed, paired sample *t*-tests were used to compare pre- and post-test results, and a two-tailed, heteroscedastic variance *t*-test was used to compare ID APPE student results to control student results. Correlation tests were used to determine relationship between ICR, TC, RB, and examination performance. Inferential (*t*-test, correlation) statistics were performed using Microsoft Excel® 2013. A *p*-value of < .05 was considered statistically significant.

Results

A total of 40 students (35 experimental, 5 control) were included in the pre- and post-test analysis (Table 1). Average pre- and post-rotation examination scores were 61.7 (10.9)% versus 80.2 (7.9)% in the experimental group ($p < .05$), while control students scored 62.0 (5.1)% ($p = .92$ and $p < .05$ versus pre- and posttest experimental student scores, respectively). No heterogeneity in scores was seen among preceptors.

On average, the number of ICR taken prior to the ID elective APPE was 1.3 (1.0) rotation, with a range of 0–3. In control students, ICR was 2 (0.7) (median = 2; range = 1–3) at the completion of the APPEs ($p = 0.10$ compared to experimental students). Average TC scores were 81.5 (3.9)% in students taking an ID APPE and 79.2 (2.0)% in control students ($p = .08$), while the general class average was 79%. Finally, students were on the ID rotation in each block from RB 1 to 8, with an average RB of 4.6 (2.3) (median RB = 4). Weak but positive correlations in ICR, TC, and RB were seen with pre-examination performance ($R = 0.5, 0.5, \text{ and } 0.4$,

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