RESEARCH

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Impact of Pharmacy Students on a Level II Trauma Center

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ABSTRACT

This study aims to quantify the benefits of allowing advanced pharmacy practice experience (APPE) students to make medical interventions while on rotation by analyzing their interventions made and the resulting cost avoidance. This retrospective, observational cohort study was completed using self-reported data of APPE student interventions made at a Level II trauma center, under the supervision of a clinical pharmacist. Interventions were analyzed for their impact on patient care and cost avoidance through a comprehensive literature search and online Quantifi reference. A total of 187 interventions over a 7-month study period resulted in an estimated cost avoidance of $26,175. Advanced pharmacy practice experience students acting as pharmacist extenders resulted in a monthly cost avoidance of $3,739, which corresponds to $44,871 per year. Incorporating student pharmacists as active members of an interprofessional team enhanced patient care by increasing medical interventions, leading to increased cost avoidance by optimizing medication regimens.

Key Words

Cost avoidance, Pharmacy interventions, Pharmacy students, Trauma center

The number of adverse drug events reported to the Food and Drug Administration in the United States has been continuously increasing over the past decade, with 470,261 reports received in 2006 and 1,289,133 reports received in 2014 (U.S. Food and Drug Administration, 2015) Current literature has already established the benefit of expanding the roles of clinical pharmacists within interprofessional health care teams, examining cost avoidance and a reduction in the number of adverse drug events (Michalets, Creger, & Shillinglaw, 2015). One study conducted over a 2-year period at a neurotrauma intensive care unit examined the outcomes of expanding the roles of clinical pharmacy practitioners on a critical care team by allowing them to modify drug therapy. The clinical pharmacy practitioners worked under the supervision of the director of trauma surgery and critical care and were given the rights to initiate, modify and discontinue medications within the scope of practice, as well as order any pertinent laboratory tests. At the end of the 2-year period, 13,386 interventions were documented, with an estimated cost savings of $2,118,426 (Michalets et al., 2015).

In addition to expanding the roles of pharmacists, medical centers are utilizing student pharmacists on their advanced pharmacy practice experience (APPE) rotations as pharmacist extenders on interprofessional health care teams. The Accreditation Council for Pharmacy Education requires all Doctor of Pharmacy students to complete a minimum of 36 weeks of APPE rotations prior to graduation. The primary purpose of these rotations is to prepare students to practice independently upon graduation (Accreditation Council for Pharmacy Education, 2014)

The benefit of using APPE students as pharmacist extenders is a topic of growing interest. Current literature provides examples that there is a benefit in allowing APPE students to be active members of the health care team by improving patient outcomes and cost avoidance (Campbell, Nelson, Elliott, Hieber, & Sommi, 2011; Delgado, Kernan, & Knoer, 2014; Marino, Caballero, Llosent, & Hinkes, 2010; Shepler, 2014). In 2011, the Cleveland Clinic of Florida had APPE students work under the supervision of pharmacists to expand direct patient care. Students performed medication histories, patient education, discharge counseling, and medication profile reviews for their assigned patients. Expanding the role of APPE students improved the Hospital Consumer Assessment of Healthcare Providers and Systems score on "communication of medication," increased overall patient interventions, and expanded the discharge prescription program at Cleveland Clinic of Florida (Delgado et al., 2014).

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Our study aimed to examine direct patient care and cost avoidance to monitor the impact of APPE students on a trauma service. We believe that the interventions made by APPE students result in improved patient outcomes and cost avoidance.

METHODS

Study Design

This retrospective, observational cohort study was completed using data collected at a Level II trauma center, which is part of a 383-bed medical center. The trauma center provides services to adult acute care patients who typically require admission to the intensive care unit or burn unit. The trauma team comprised physicians, medical residents, physician assistants, clinical pharmacists, nurses, and APPE pharmacy students based on their rotation schedule.

Student pharmacists on their APPE rotations made medical interventions under the supervision of a clinical pharmacist. The interventions were analyzed for cost avoidance, based on the types of interventions made and the quantity. During the 4-week APPE rotation blocks students participated in interdisciplinary rounds with the trauma team and were directly involved in managing patient treatment plans. Students reviewed patient profiles daily and made recommendations that were approved by the pharmacist and the patient's physician prior to implementation. This study was submitted and deemed exempt by the institutional review board.

Data Collection and Analysis

From December 2014 to August 2015 students self-reported approved interventions and recorded them in a spreadsheet. All data were void of patient identifiers prior to being received by the researchers. During the months of March and May students were not scheduled for rotations, therefore, these months were excluded from all calculations.

To examine the impact the interventions had on direct patient care, researchers analyzed the data with descriptive statistics, focusing on the different types of interventions made in each intervention category. Cost avoidance calculations were determined with a comprehensive literature search of MEDLINE and PubMed databases, which produced a small return of relevant articles. An online Quantifi Intervention Cost Savings Justification source and an article published in 2012 examining the cost avoidance associated with pharmacist interventions in a Level I trauma center were utilized in determining the cost avoidance for each intervention (Hamblin, Rumbaugh, & Miller, 2012; Westergard, 2004). The costs of each intervention type were compared with the two sources and aligned with the types of interventions made in this study. Costs were adjusted using the Consumer Price Index Inflation calculator from the Bureau of Labor Statistics (U.S. Bureau of Labor Statistics, 2015). The cost avoidance calculations did not take into account staff salaries as previously published studies have done, since it was not believed that any of the interventions made by the students would warrant a change in daily staffing requirements.

Outcomes

Outcome measures were selected on the basis of the types of interventions students were making that align with what is currently found in the literature. Outcomes of interest include the impact on direct patient care through interventions made by APPE students (i.e., anticoagulation, antimicrobial stewardship, therapeutic recommendation, hyperglycemia management, discharge counseling, dosage form change, drug information, pain management, renal dosing, medication reconciliation, and other) and cost avoidance to the medical center as a result of these interventions.

RESULTS

During the 7 months of data, 13 APPE students made a total of 187 patient interventions, with an estimated cost avoidance of $26,175. The interventions were divided into 43% therapeutic recommendation, 15% discharge counseling, 12% drug information questions, 10% antimicrobial stewardship, 9% dosage form change, 4% optimized anticoagulation, 4% medication reconciliation, and 3% renal dose adjustments. However, the impact of addressing drug information questions could not be determined since the questions were not always asked about specific patients.

The most common type of interventions made were therapeutic recommendations (n = 80), which provided an estimated cost avoidance of $14,093 ($176/intervention). Within this category, students discontinued unnecessary medications (n = 37), optimized pain management therapy (n = 17), added medications pertinent to treatment (n = 12), provided dosing recommendations (n = 3), managed hyperglycemia (n = 3) as well as other changes to optimize the patient's medication therapy (i.e., changed the time medications were being administered, replaced two medications with one, and changed one medication to another). While optimizing the treatment plans for pain management, students added medication (n = 6), discontinued unnecessary medication (n = 4), discontinued duplicate therapy (n = 2), changed frequency of administration (n = 2), as well as reordered pain medications and provided patient education.

Antimicrobial stewardship provided an estimated $4,145 in cost avoidance, with the largest estimated cost avoidance per intervention ($230/intervention), shown in Table 1. This intervention category could be further broken down into discontinuing antibiotics (n = 9),

TABLE 1 Interventions and Associated Cost Avoidance

Intervention Type	Total Interventions	Cost Avoidance per Intervention	Total Cost Avoidance
Anticoagulation therapy optimized	8	$208	$1,663
Antimicrobial stewardship	18	$230	$4,145
Therapeutic recommendation	80	$176	$14,093
Discharge counseling	29	$96	$2,784
Dosage form change	16	$64	$1,024
Drug information	22	$0	$0
Renal dosing adjustments	6	$176	$1,057
Medication reconciliation	8	$176	$1,409
Total	187		$26,175

changing antibiotics (n = 2), dosing recommendations (n = 3), initiating treatment (n = 2), and switching two antibiotics to one (n = 1).

Figure 1 displays the most frequent types of interventions made within the various intervention categories. After analyzing the data collected, the most frequent type of intervention was discontinuing unnecessary medication.

The calculated total cost avoidance for the 7-month study period was determined to be $26,175. Utilizing the total cost avoidance, it is estimated that the interventions made by the APPE students produced a monthly cost avoidance of about $3,739, which corresponds to a total estimate of $44,871 per year.

DISCUSSION

Advanced pharmacy practice experience rotations are a time for pharmacy students to begin fostering the skills necessary for them to become successful pharmacists. Many of the institutional rotation sites offered to students involve students making independent clinical decisions before having them approved by their preceptor. The students involved in this study were given the opportunity to review patient profiles daily and identify any drug-related problems. Only the interventions that were not prompted and were approved by the preceptor were included in the study. The results from this study suggest that the interventions made by the pharmacy students had a positive impact on the trauma center.

The impact interventions had on direct patient care were interpreted based off of the types of interventions made (Figure 1 and Table 1). The most frequent therapeutic recommendation made by the students was to discontinue unnecessary medications (n = 52; 27.81%). Through discontinuing medications that were not needed, students helped minimize exposure to medications that may have risk of adverse effects and/or toxicity to the patients, as well as avoiding costs by saving resources. Furthermore, students were able to initiate medications

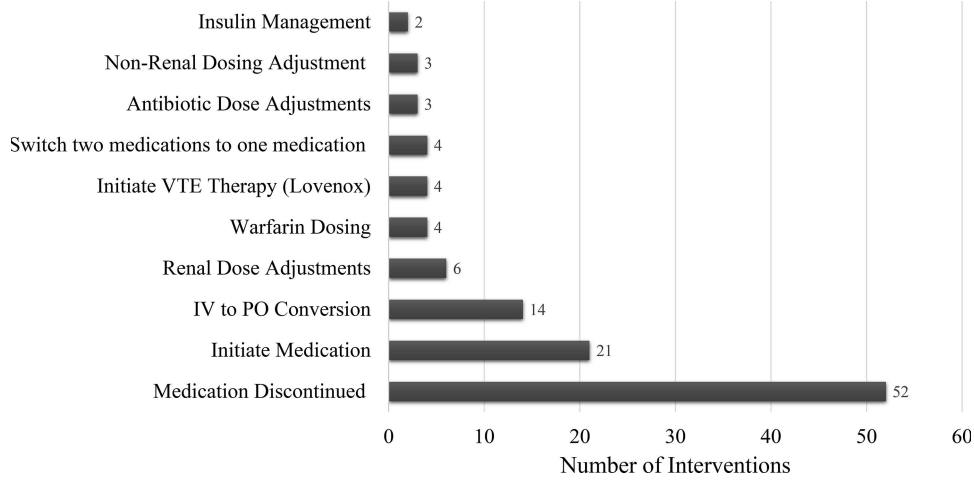

Figure 1. Types of interventions further broken down. IV = intravenous; PO = oral; VTE = venous thromboembolism.

(n = 21; 11.23%) that patients should have been prescribed to optimize their medication therapy and help improve outcomes. Students also recommended dosing (renal adjustments: n = 6; 3.21%; and nonrenal adjustments: n = 3; 1.0%), changes to warfarin therapy (n = 4; 2.14%), and changes to antibiotic therapy (n = 3; 1.60%).

Current literature primarily focuses on the impact that pharmacist interventions have on cost avoidance, rather than student interventions. A study conducted at Vanderbilt University Medical Center's Level I Trauma Center determined the net cost savings of having a clinical pharmacist on his or her interdisciplinary trauma team to be $428,327, during a 1-year study period. This article was utilized as a comparator to an online Quantifi resource to conduct the data analysis for cost avoidance in our study (Hamblin, Rumbaug, & Miller, 2012; Westergard, 2004). The intervention categories assessed in the Level I trauma center study aligned with the majority of the interventions we analyzed. A number of factors contribute to the vast difference in our estimated avoidance compared with the other study, including but not limited to number of interventions, the individuals making the interventions, size of the trauma centers, and number of types of interventions examined. When pharmacy students are used as pharmacist extenders as our study has done, it results in additional cost avoidance compared with clinical pharmacists alone.

One study examined the integration of pharmacy students in a Level II trauma center and specifically examined the students' abilities through the use of an ability-based outcomes (ABO) assessment, which was completed by their preceptor at the end of their 8-week APPE rotation (Petrie, 2011). The ABO assessment measured areas or skills that are beneficial to pharmacists, such as: effective communication, drug therapy assessment, decision making, drug information retrieval, critical thinking, and problem solving (Petrie, 2011). The areas where students needed improvement included effective communication skills and self-confidence (Petrie, 2011). Advanced pharmacy practice experience rotations provide students with an opportunity to develop their self-confidence and communication skills, which are displayed differently by students who are in the end of their rotation year versus students who are just beginning. Rotations that allow students to autonomously act to make patient interventions can help promote self-confidence in the students.

Pharmacy students do not always possess confidence in their skills at the beginning of their clinical rotation year, which could limit the number and types of recommendations they make. In addition, the students who were included in our study were only at the site for a 4-week period, during which they had to become acclimated to the medical center, the electronic medical records system, and practicing as a trauma pharmacist intern, all of which is new to the students. The first week of the rotation period is typically filled with orientation activities to help them adjust to the new site; therefore, students were not actively making recommendations every day during their rotation.

The capabilities, personality, and level of confidence for each student appeared to have an impact on the quantity and quality of interventions made each month. Students who possess great self-confidence in their own capabilities and are more outgoing could be more comfortable making interventions for patients. For example, during 1 month there was only one student on the rotation who made the second highest amount of interventions (n = 28) that month alone, compared with every other month that had two students (average number of interventions per student = 14.28). External factors may impact the interventions students make (i.e., number of patients in the trauma center and staffing components); however, it does appear that the way they view themselves plays a role, which could be a topic for further research.

Limitations of this study include the data being self-reported by the students as well as the cost avoidance estimates calculated from current literature. The nature of it being self-reported leaves room for under reporting. To minimize reporting errors in the data, researchers thoroughly examined each intervention and the notes associated with them to determine whether the intervention was correctly categorized and relevant to the outcomes. To provide a more accurate estimate of cost avoidance values, an electronic reporting system could have been utilized to record data and calculate the cost of each intervention. Researchers did not own an electronic reporting or cost calculating system, which led to the determination of costs through online resources.

As pharmacist roles within health care teams expand, it is important for pharmacy students to gain early exposure to working closely with interdisciplinary health care teams, which will benefit everyone involved. A survey-based study of inpatient internal medicine providers found pharmacy students to be well prepared and beneficial to the medical team (Lancaster, DiVall, Douglass, & Woolley, 2011). In current literature, there are examples of student pharmacists making a positive impact on patient care. However, it is believed that this is the first study to quantify the cost avoidance with the interventions made within a Level II trauma center.

The integration of student pharmacists into the trauma team has increased the number of interventions being made, helping optimize patient care. In addition, the student pharmacists are contributing to added cost avoidance due to enhanced patient care. The results of this study are not generalizable to all trauma centers, and not every trauma center will integrate student pharmacists in their trauma teams. However, given the progressive

nature of trauma, it is crucial for trauma centers to continuously strive to find new ways to optimize patient care to the highest standards. Further research in this field could be done examining the impact students from other professions have on patient care when given the opportunity to practice as extenders of their supervisors.

CONCLUSION

The integration of student pharmacists into a trauma team at a Level II trauma center enhanced patient care through an increased amount of medication-related interventions. Improving patients' treatment plans ultimately led to an increased cost avoidance for the medical center through discontinuing unnecessary medications and optimizing medication regimens.

KEY POINTS

- Pharmacy students on their advanced practice pharmacy experience (APPE) rotations are able to work as pharmacist extenders.
- The medical interventions made by APPE students resulted in increased cost avoidance at a Level II trauma center.
- APPE students can be successfully integrated in interprofessional trauma teams and make contributions to the treatment of patients.

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