

RESEARCH

Student Pharmacists' Clinical Interventions in Advanced Pharmacy Practice Experiences at a Community Nonteaching Hospital

Angela O. Shogbon, PharmD, and Lisa M. Lundquist, PharmD

College of Pharmacy, Mercer University, Atlanta, Georgia

Submitted August 24, 2013; accepted November 1, 2013; published April 17, 2014.

Objective. To assess student pharmacists' clinical interventions in advanced pharmacy practice experiences (APPEs) at a community nonteaching hospital and evaluate completed interventions based on the type of documentation method used.

Methods. Clinical interventions of 120 fourth-year (P4) student pharmacists in advanced institutional, medication safety, or internal medicine APPEs were collected over a 3½-year period. Clinical interventions were analyzed for cost savings, intervention type, and acceptance rates. A secondary analysis of paper-based vs electronic-based documentation of completed interventions was performed.

Results. There were 2,170 clinical interventions attempted with an acceptance rate of 97%. The estimated cost savings was \$280,297. A comparable number of interventions and cost savings per student was observed between paper-based and electronic-based documentation methods.

Conclusion. Student pharmacists at a community nonteaching hospital have many opportunities for participation in patient-centered activities, and for interaction and collaboration with other healthcare professionals. They can significantly benefit patient care through clinical interventions, while also contributing to cost savings for the institution.

Keywords: advanced pharmacy practice experience, clinical interventions, student pharmacists, nonteaching hospital

INTRODUCTION

The Accreditation Council for Pharmacy Education (ACPE) requires that the curricula of colleges and schools of pharmacy lead to the development of graduates who contribute to patient care in collaboration with patients, prescribers, and other members of the healthcare team.¹ The ACPE highlights several aspects of students' contributions to patient care in preparation for their role as future pharmacists, including providing patient education, optimizing the pharmaceutical care of patients, and communicating with other healthcare providers. The ACPE also recommends the documentation and assessment of the nature and extent of students' interactions with patients and healthcare professionals.

Several studies have evaluated the impact of student pharmacists at experiential practice sites in different healthcare settings in relation to the types and significance of clinical interventions, as well as on cost savings to the institution.²⁻¹¹ Student pharmacists have had a significant

impact in improving patient care and in providing cost savings to the institution. While at the experiential practice sites, each student pharmacist made an average of 1.2 to 16 recommendations per week to prescribers, with an acceptance rate of 32% to 98%.¹¹ Cost savings or cost avoidance was also associated with having student pharmacists at experiential sites.

Most published studies report the impact of student pharmacists in teaching institutions,^{3-4,7-10} although some do not specify the teaching status of the site.^{2,6} These studies have evaluated students in a variety of APPEs, including ambulatory care, internal medicine, pediatrics, and psychiatry. Although academic medical centers are ideal sites for training student pharmacists, community nonteaching hospitals are viable training sites for student pharmacists given the growing need for experiential education sites and the limited availability of teaching hospitals in certain geographic locations.

There are several major differences between teaching hospitals and community nonteaching hospitals. Medical personnel at community nonteaching hospitals are primarily independent practitioners who may be hospitalists with full-time hospital-based practices or consultant physicians with outpatient clinic-based practices, while medical personnel at teaching hospitals usually include

Corresponding Author: Angela O. Shogbon, PharmD, Clinical Assistant Professor, Mercer University College of Pharmacy, 3001 Mercer University Drive, Atlanta, GA 30341. Tel: 678-547-6116. Fax: 678-547-6384. E-mail: Shogbon_ao@mercer.edu

medical students, interns, residents, and attending physicians. Thus, each setting affords a different level of interaction and communication in terms of clinical recommendations between student pharmacists and the medical team, ie, student pharmacists mostly interact with medical students and residents in a teaching hospital, compared with attending physicians in community nonteaching hospitals. In academic medical centers, pharmacists and student pharmacists attend multidisciplinary rounds as part of a service, while pharmacy practitioners in community nonteaching hospitals practice with more independence.¹² In this setting, pharmacy practitioners typically monitor patients in specific regions of the hospital, and independently collect and analyze patient information as they perform medication therapy management services. Community nonteaching hospitals provide student pharmacists with a great opportunity for one-on-one interactions with physicians and other healthcare providers, and give students the opportunity to develop interpersonal skills and to work as part of an interdisciplinary team.¹² This setting also provides students with a greater one-on-one consultation time with their patients compared to medical team rounds, whereby attending physicians or medical residents take the lead roles in patient interactions, allowing student pharmacists minimal patient interaction during rounds. While student pharmacists can proactively make recommendations to the medical team on rounds at teaching hospitals, the nature of the clinical recommendations in nonteaching hospitals may be reactive to orders a physician has already placed. However, in this setting, pharmacists and student pharmacists are also consulted by independent practitioners. They serve as a resource to discuss medication therapy goals and proactively make recommendations to improve patient care.^{12,13}

Clinical interventions performed by students in community nonteaching hospitals can be documented using either paper or electronic documentation instruments, based on the resources available at the site. Electronic systems are more efficient than paper-based systems because they allow documentation of increased number and types of pharmacists interventions.¹⁴ To our knowledge, there are no published studies that compare differences in documentation rates when paper vs electronic documentation instruments are used for student pharmacist interventions.

The primary purpose of our study was to assess student pharmacists' interventions in APPEs at a community nonteaching hospital by evaluating clinical interventions for cost savings, intervention types, and acceptance rates. Secondary endpoints included assessing interventions and estimated cost savings by type of APPE, and evaluating

students' number of interventions and associated cost savings during the paper-based documentation period vs a comparative time period when electronic documentation was used.

METHODS

This study involved a review of clinical interventions by P4 students who completed a 5-week advanced institutional, medication safety, or internal medicine APPE over a 3½-year period from June 2009 to December 2012 (excluding April and May 2010) at 1 community nonteaching hospital. As part of the APPE expectations, students participated in clinical activities to optimize medication therapy management and patient safety. All APPE activities were performed under the supervision of pharmacist preceptors. The students were required to document all clinical activities performed, which served as a learning tool for the students on how pharmacists keep track of clinical interventions. Our analysis included data from all student pharmacists in the 3 APPEs who were trained on intervention documentation and documented at least 1 intervention during their experiential education. Entries were reviewed by the pharmacist preceptor and duplicate entries by the same student were excluded.

Clinical interventions involved written and verbal interactions with other healthcare professionals, patients, and caregivers, and were documented on a paper data collection form for the first 1½ years of the study (June 2009 to December 2010). All data collected were collated by APPE type and subsequently entered into an Internet-based documentation system, Quantifi, (Pharmacy OneSource, Bellevue, WA) by pharmacist preceptors for analysis of intervention types, acceptance rates, and cost savings. Beginning in January 2011, students entered their interventions directly into Quantifi, which was available through a subscription to Pharmacy OneSource. Interventions were classified into the following areas: therapeutic (antibiotic recommendations, medication initiation/discontinuation, therapeutic interchanges, intravenous (IV) to enteral route conversions), safety (dose evaluation, drug interactions, allergy information clarification, lab evaluation), quality assurance (medication history, duplicate avoidance), and information/education (drug information, patient education, drug therapy consultation). Students were instructed at the start of their APPE by pharmacist preceptors on how to appropriately document clinical interventions using the documentation instrument in use (paper vs electronic), and this training was consistent over time and across all of the 3 types of APPEs. A pharmacist reviewed each intervention entered by the students for appropriateness and accuracy of documentation, and intervention classification.

Interventions were considered accepted if they resulted in a change in the patient's therapy in line with the recommendation made (eg, therapeutic and safety classes), if the recipient of patient education or drug information agreed to the recommended counseling or information provided, or if the intervention resulted in a verification of the patient's medication history (eg, quality assurance). Cost savings were calculated using the variables and assumptions made by Quantifi, which was based on literature evaluation and cost savings calculations to derive hard and soft cost savings for each type of intervention. Hard cost savings included cost savings based on a clinical intervention made and applied to interventions such as IV to enteral route conversions, therapeutic interchanges, and antibiotic recommendations. The hard cost savings were calculated using an average cost differential between commonly interchanged drugs or antibiotics and a days of therapy impacted factor in order to calculate the average value of the intervention made. Soft cost savings referred to cost avoidance from the prevention of a potential adverse drug event when an intervention was made; for example, allergy information clarification. The soft cost savings were calculated by using one half of the average inflation and adverse drug event rate values supported by literature to generate a realistic and conservative number. The cost measures used by Quantifi were last updated in 2009 and were not adjusted for annual inflation costs thereafter.

Interventions from students during the medication safety APPE were excluded from the paper vs electronic documentation analysis because the APPE changed during this time period from medication safety projects to a focus on medication reconciliation. The advanced institutional and internal medicine APPEs did not undergo any changes during the study period and were included in this secondary analysis. Descriptive statistics, including mean and percentages, were used to analyze data obtained. Data for individual students were not available for analysis because data were collated by APPE type; however, per student assessments were calculated by dividing the total interventions by the total students in the time period. Mercer University's Institutional Review Board reviewed and approved this study.

RESULTS

One hundred twenty P4 student pharmacists who completed their advanced institutional, medication safety, or internal medicine APPEs over the 3½-year study period, and who documented at least 1 intervention and were trained on documentation of clinical interventions, were included in this study. Clinical interventions from the students in the medication safety APPE (n=21), advanced

institutional APPE (n=29), and internal medicine APPE (n=70) were collected and analyzed. Students reported a 97% acceptance rate (2,107 accepted of 2,170 attempted) for clinical interventions (Table 1) with an estimated cost savings for the institution of \$280,297 (Table 2). Each student performed an average of 18 interventions (3.6 interventions per week) with an average cost savings of \$2,335 per student. The most common types of interventions performed were information/education (patient education), quality assurance (medication history), and therapeutic (intravenous to enteral route screening and conversions).

An analysis of interventions documented using the paper-based documentation instrument from June 2009 to December 2010 vs those documented using the electronic documentation instrument during a comparative time period from June 2011 to December 2012 was performed. The average number of interventions and cost savings per student in the advanced institutional and internal medicine APPEs during the paper documentation period was 15 interventions and \$1,782, respectively, and during the electronic documentation period it was 14 interventions and \$1,764, respectively.

DISCUSSION

Student pharmacists in the advanced institutional, medication safety, and internal medicine APPEs at a community nonteaching hospital had more than 2,000 opportunities to intervene in the care of patients through interaction with other healthcare providers, patients, and caregivers. These clinical interventions were well received, with an overall acceptance rate of 97% and a total estimated cost savings of \$280,297 over a 3½-year period. There was a higher number of specific interventions, such as information/education and therapeutic, because of the students' weekly participation in specific clinical activities at the practice site, including warfarin education, and intravenous (IV) to enteral route screening and conversions per hospital protocol. Medication safety APPE students had a higher number of quality assurance (medication history) interventions because of a primary focus on medication reconciliation as a component of this APPE. Internal medicine students had a higher number of therapeutic and information/education interventions because of the nature of the activities of this APPE. They also had the opportunity to perform drug therapy consultations and to educate patients on different medication therapies.

There were a comparable number of interventions and cost savings per student when comparing paper vs electronic documentation of interventions performed during comparative time periods. Students' rate of documentation of interventions did not significantly change when

Table 1. Attempted Clinical Interventions by Fourth-Year Pharmacy Students in Advanced Pharmacy Practice Experiences at a Community Nonteaching Hospital and Associated Acceptance Rates, N=2170

Intervention Class	Advanced Institutional		Medication Safety		Internal Medicine		Total	
	Attempted, No.	Accepted, %	Attempted, No.	Accepted, %	Attempted, No.	Accepted, %	Attempted, No.	Accepted, %
Therapeutic (antibiotic recommendations, medication initiation/discontinuation, therapeutic intravenous to enteral route conversions)	58	100	65	100	382	93.2	505	94.9
Safety (dose evaluation, laboratory evaluation, allergy information clarified, drug interactions)	6	83.3	21	100	194	87.6	221	88.7
Quality assurance (medication history, duplicate avoidance)	3	100	425	100	147	96.6	575	99.1
Information/education (drug information, patient education, drug therapy consultation)	177	98.9	144	100	548	99.1	869	99.2
Overall	244	98.8	655	100	1271	95.3	2170	97

using paper-based vs electronic-based documentation systems as long as students were oriented appropriately to the documentation system being used, and informed of the importance and expectation to document interventions. For institutions that still use paper-based documentation systems for student pharmacist interventions, this can be an effective tool to capture the activities of students at the experiential practice site.

Previous studies have described the positive impact of student pharmacists in various clinical settings and their associated cost savings, and most of these studies also describe the impact in teaching institutions.^{3-4,7-10} Student pharmacist interventions were evaluated from time periods of 5 months to 3 years, with an average of 2.3 to 12 interventions per student per week and an acceptance rate ranging from 68% to 97%.^{3-4,7-11} In our study, comparable results were seen with each student performing an average of 3.6 interventions per week and an acceptance rate of 97% at a community nonteaching hospital.

We identified some limitations in our study. Students may have documented only interventions they recollected based on the perceived favorable outcome on patient care.⁸ In addition, they may have been more likely to document the interventions that got accepted. This may have underestimated the total clinical interventions performed and inflated the number of accepted interventions.

Interventions made per protocol (eg, IV to enteral route conversions) did not require prior approval by a prescriber, which may have resulted in students documenting more of this type of intervention and increased the number of accepted interventions. Even though cost savings were calculated and reported, it is unknown if the accepted interventions reduced length of stay, readmission rates, or overall healthcare costs.^{7,11} Student pharmacists' interventions were all performed under the supervision of the pharmacist preceptors; however, for some interventions, the student may have received assistance from the preceptor in performing the intervention. The number of interventions for which students received assistance vs those that were student driven were not quantified. Pharmacist interventions at this practice site were not documented using the same documentation instruments as the students, so comparisons using a comparator group for the students' interventions could not be made.

The performance and documentation of clinical interventions by students helps to contribute to their active-learning process and preparation as future pharmacists. It helps them to identify what a clinical intervention is and the various types, and teaches students professional communication, including documentation of pharmacist recommendations and consultations, in line with ACPE outcomes.¹ This process also helps students realize the

Table 2. Accepted Clinical Interventions and Cost Savings^a of Fourth-Year Pharmacy Students in Advanced Pharmacy Practice Experiences at a Community Nonteaching Hospital, \$

Intervention Class	Advanced Institutional (n=241)	Medication Safety (n=655)	Internal Medicine (n=1211)	Total Accepted (n=2107)
Therapeutic	1,537	1,513	31,682	34,732
Safety	765	3,213	26,010	29,988
Quality Assurance	459	65,025	21,726	87,210
Information/Education	26,316	21,573	80,478	128,367
Cost Savings	29,077	91,324	159,896	280,297

^a Cost savings were calculated using the variables and assumptions made by Quantifi (Pharmacy OneSource, Bellevue, WA).

influence they have on patient care and may provide them with a better understanding of an interdisciplinary approach to patient care through interactions with other healthcare providers. The cost savings documented may help to justify the benefit of the presence of student pharmacists at practice sites, including community nonteaching hospitals, and may aid with justifying increasing the number of students at these sites in order to increase the potential benefit to patient care and cost savings to the hospital.

CONCLUSION

Student pharmacists in APPEs at a community nonteaching hospital had more than 2,000 opportunities within a 3½-year period to participate in clinical activities, interact and collaborate with other healthcare professionals, and positively influence the care of patients, while also contributing to pharmacy cost savings. These activities provided students with the opportunity to learn and demonstrate ACPE competencies in experiential education, specifically in contributing to patient care in collaboration with patients, prescribers, and other members of the healthcare team.

ACKNOWLEDGMENTS

The authors acknowledge Kathryn M. Momary, PharmD, for her aid in statistical analysis.

REFERENCES

1. Accreditation Council for Pharmacy Education. Accreditation standards and guidelines for the professional program in pharmacy leading to the doctor of pharmacy degree. <https://www.acpe-accredit.org/pdf/FinalS2007Guidelines2.0.pdf>. Accessed July 15, 2013.
2. DiVall MV, Zikaras B, Copeland D, Gonyeau M. School-wide clinical intervention system to document pharmacy students' impact on patient care. *Am J Pharm Educ.* 2010;74(1):Article 14.

3. Taylor CT, Church CO, Byrd DC. Documentation of clinical interventions by pharmacy faculty, residents, and students. *Ann Pharmacother.* 2000;34(7-8):843-847.
4. Pham DQ. Evaluating the impact of clinical interventions by PharmD students on internal medicine clerkships: the results of a 3 year study. *Ann Pharmacother.* 2006;40(9):1541-1545.
5. Slaughter RL, Erickson SR, Thomson PA. Clinical interventions provided by doctor of pharmacy students. *Ann Pharmacother.* 1994;28(5):665-670.
6. Stevenson TL, Fox BI, Andrus M, Carroll D. Implementation of a school-wide clinical intervention documentation system. *Am J Pharm Educ.* 2011;75(5):Article 90.
7. Condren ME, Haase MR, Luedtke SA, Gaylor AS. Clinical activities of an academic pediatric pharmacy team. *Ann Pharmacother.* 2004;38(4):574-578.
8. Pound MW, Miller SM. Written vs oral recommendations made by pharmacy students during internal medicine rotations. *Ann Pharmacother.* 2007;41(5):772-776.
9. Lundquist LM, Moye PM. Resident physicians' acceptance of pharmacy students' pharmacotherapy recommendations during an ambulatory care advanced pharmacy practice experience. *Am J Pharm Educ.* 2009;73(8):Article 145.
10. Campbell AR, Nelson LA, Elliott E, Hieber R, Sommi RW. Analysis of cost avoidance from pharmacy students' clinical interventions at a psychiatric hospital. *Am J Pharm Educ.* 2011;75(1): Article 8.
11. Mersfelder TL, Bouthillier MJ. Value of the student pharmacist to experiential practice sites: a review of the literature. *Ann Pharmacother.* 2012;46(4):541-548.
12. Paciullo CA, Moranvile MP, Suffoletta TJ. Pharmacy practice residency programs in community hospitals. *Am J Health-Syst Pharm.* 2009;66(6):536-539.
13. Crader MF, Chelette CT. A beneficial partnership between hospitals and colleges of pharmacy: development and discussion of a joint cooperative endeavor agreement. *Hosp Pharm.* 2010;45(9):697-704.
14. Fox BI, Felkey BG, Berger BA, Krueger KP, Rainer RK. Use of personal digital assistants for documentation of pharmacists' interventions: a literature review. *Am J Health-Syst Pharm.* 2007; 64(14):1516-1525.