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Pharmacy Student Intervention Acceptance on a Cardiology Rotation

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Abstract

Background: There is little information published for experiential sites where pharmacy students do not round with prescribers.

Aims: The goal of this retrospective study was to assess student interventions on an inpatient rotation in a private, non-academic medical centre.

Methods: Students (n=100) on rotation between June 2008 and March 2013 were included. Associations between acceptance rate (AR) and time and AR and number of interventions per student were assessed using the Cochran-Armitage Trend test.

Results: A total of 1,114 interventions were analysed with a mean AR of 40.5% (451). There was a statistically significant increase in the probability of acceptance as the academic year progressed (p=0.0118) and an increase in the probability of acceptance as the years progressed from 2008 to 2013 (p=0.0118).

Conclusion: This study demonstrated that as experience was gained through the academic year, written student interventions were more likely to be accepted by prescribers.

Keywords: *Cardiology, intervention, pharmacy student.*

Introduction

The American Association of Colleges of Pharmacy (AACP) Education Centre for Advancement of Pharmacy Education (CAPE) 2013 Educational Outcomes emphasise inter-professional collaboration and the ability of pharmacy students to "Actively participate and engage as a healthcare team member by demonstrating mutual respect, understanding, and values to meet patient care needs." (American Association of Colleges of Pharmacy, 2013). An important part of this collaboration with the health care team is the ability of pharmacy students to make therapeutic recommendations to other providers that will positively impact patient outcomes.

In addition to improving outcomes, the financial impact of pharmacy student interventions can be significant. In 1999, Brockmiller *et al.* found an annual cost benefit of $354,752 for pharmacy student interventions at Indiana University Medical Centre where these interventions made up 13% of all pharmacy interventions (Brockmiller, 1999). A similar study at that time demonstrated an annual cost savings of $521.81 per student (Dennehy, 1998). More recently, significant cost savings of $2,721-$7,533 per student and a mean cost avoidance of $617 per student rotation have been reported (Pillen, 2005; Stevenson, 2011).

Common therapeutic interventions made by pharmacy students include changes in drug therapy regimens, changes in dose, laboratory monitoring, and identification of potential drug-drug interactions (Slaughter, 1994; Lundquist, 2009). The prescriber acceptance rate of pharmacy student interventions reportedly ranges between 54.2% and 97.9% (Table I).

To date, two studies have compared the acceptance rate between written versus oral student interventions. Lundquist *et al.* found that oral pharmacotherapy recommendations made by pharmacy students to medical residents in an ambulatory clinic had significantly greater acceptance rates when compared to written recommendations in the same clinic (97.9% versus 83.6%, p<0.0001) (Lundquist, 2009). Pound & Miller found that the acceptance rate for written interventions during an inpatient internal medicine rotation was 54.2% compared to 82.8% when interventions were delivered orally during rounds at the same institution (p<0.0001) (Pound & Miller, 2007). One study surprisingly found a greater acceptance rate of student interventions (92%) versus staff pharmacist interventions (83%) (Pham, 2006). Sklar *et al.* found similar results (89% acceptance rate for students and 72% for preceptor) (Sklar, 2002). Pham suggested that the students' interventions were better accepted because the students were in direct daily contact with prescribers while the pharmacists were communicating more by telephone (Pham, 2006).

Direct oral communication with a prescriber certainly seems to greatly increase intervention acceptance rate. However, some institutions, especially non-academic, are still not conducive to frequent face to face communication with prescribers. This can be due to lack

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of residents and fellows and greater presence of mid-level providers, lack of team rounding and/or patient conferences, and a greater patient load for both prescribers and pharmacists due to minimal teaching responsibilities and funding constraints.

Table I: Summary of Literature Reporting Acceptance Rate of Pharmacy Student Interventions

Study	Number of Students	Type of Rotation	Institution	Prescriber Acceptance Rate	Intervention Method
Mueller 1990	7	Inpatient	Academic Medical Center	88.8%	Oral to the team
Briceland 1992	4	Inpatient	Academic-Affiliated Medical Center	94.8%	"Presented to Prescribers"
Slaughter 1994	6	Inpatient and Ambulatory	Academic-Affiliated Medical Centers and Outpatient Clinics	79%	Not Stated
Dennehy 1998	27	Inpatient	Academic Medical Center	92.5%	Oral
Reddick 2000	10	Inpatient and Outpatient	Multiple	64%	Mixed
Manoguerra 2000	17	Inpatient	Academic-Affiliated Medical Center	79.4%	Not Stated
Rospond 2000	Not Stated	Inpatient and Outpatient	Multiple	81.6%	Mixed
Sklar 2002	8	Inpatient	Academic Medical Center	89%	Not Stated
MacKinnon 2003	93	Inpatient and Outpatient	Multiple	87.1%	Mixed
Pham 2006	63	Inpatient	Academic-Affiliated County Hospital	92%	Oral
Pound 2007	10	Inpatient	Community Teaching Hospital	82.8% oral 54.2% written	Mixed
Lundquist 2009	14	Ambulatory	Academic Internal Medicine Clinic	97.9% oral 83.6% written	Mixed
DiVall 2010	94	Inpatient and Outpatient	Multiple	59.6%	Mixed

To date there have been no studies assessing the therapeutic interventions of pharmacy students on an inpatient cardiology rotation. In light of recent healthcare reform, the emphasis on reduction of readmissions, reduction of adverse events, and improving patient adherence, providing optimal medication therapy management is more important than ever in cardiac patients. Pharmacists and pharmacy students are uniquely positioned to improve these outcomes through therapeutic intervention and patient counselling. Therefore, a retrospective assessment of these interventions and prescriber acceptance, for a cardiology rotation in a private, non-profit medical centre was conducted.

Methods

One-hundred fourth-year pharmacy students assigned to a five-week inpatient cardiology rotation at a private, non-profit, non-academic, medical centre in Lincoln, Nebraska between June 2008 and March 2013 were included in this study. Fourth-year pharmacy students are in their final year of instruction and typically participate in a year-long experiential component of training. At this institution, pharmacy students and the faculty preceptor round autonomously on a daily basis and communicate any therapeutic interventions through a written note placed in the front of the patient chart after consultation with the pharmacy preceptor. A carbon copy of the pharmacist–provider communication form is retained by the preceptor. Interventions were then assessed for prescriber acceptance upon patient dismissal. There were four students per five-week rotation and each student was assigned eight patient beds to follow.

A therapeutic intervention was defined as any intervention made by a pharmacy student that would potentially change the course of pharmaceutical care including adding, discontinuing or changing a medication, dose change, administration timing change, dosage form change, or obtaining a laboratory value or test for drug monitoring. Interventions involving drug information questions or patient counselling were not included in this analysis. Data extracted from written prescriber interventions included intervention type, justification, drugs involved, and prescriber acceptance.

Statistical analyses were performed using SPSS Statistics version 20 (IBM Corporation, Somers, New York). Mean and standard deviations were calculated for continuous variables while a number and a percentage are reported for categorical variables.

Acceptance rate was calculated as the number of accepted interventions divided by the number of total interventions. Associations between acceptance rate and time and acceptance rate and number of interventions per student were assessed using the Cochran-Armitage Trend test. A p value less than 0.05 was considered statistically significant.

Results

A total of 1,114 interventions were analysed with a mean acceptance rate of 40.5% (n=451). Students made an average of 11±6.3 written interventions per five-week rotation. There was no significant correlation between the number of interventions per student and acceptance rate (p=0.2485).

The most common interventions were dose change (n=387) and adding a medication (n=231) (Table II). Interventions with the highest acceptance rates were class change and administration time changes, 55% and 53% acceptance rates, respectively.

Table II: Acceptance Rate by Intervention Type

Intervention Type	Total Interventions	Acceptance Rate	Non-Acceptance Rate
Change Medication Dose	387	40% (154)	60% (233)
Add a Medication	231	39% (89)	61% (142)
Medication Switch within Same Class	175	28% (49)	72% (126)
Discontinue a Medication	162	42% (68)	58% (94)
Obtain a Laboratory Value	56	52% (29)	48% (27)
Medication Switch to Different Class	40	55% (22)	45% (18)
Obtain a Test	31	39% (12)	61% (19)
Change the Administration Time	26	54% (14)	46% (12)
Dosage Form Change	6	33% (2)	67% (4)

The most common justifications for interventions were renal/liver adjustment (n=293) and drug-drug interactions (n=233) (Table III). Justifications with the highest acceptance rates were duplicate therapy and no indication, 73% and 50% acceptance rates, respectively.

Table III: Acceptance Rate by Intervention Justification

Intervention Justification Type	Total Interventions	Acceptance Rate	Non-Acceptance Rate
Duplicate Therapy	48	73% (35)	27% (13)
No Indication	2	50% (1)	50% (1)
Cost Savings	17	47% (8)	53% (9)
Improved Safety	205	44% (90)	56% (115)
Morbidity or Mortality Benefit	208	40% (83)	60% (125)
Renal/Liver Adjustment	293	38% (110)	62% (183)
Drug-Drug Interaction	233	38% (89)	62% (144)
Patient Not Meeting a Goal	110	33% (36)	67% (74)

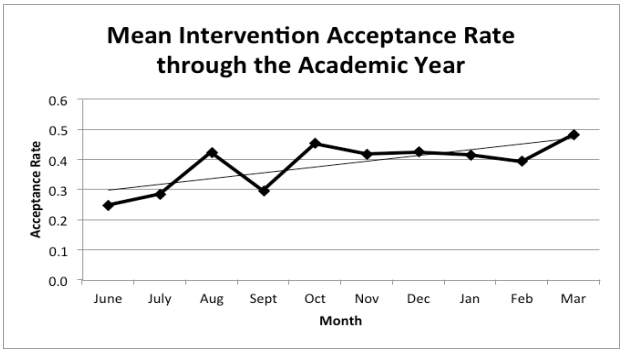
Table IV summarises the most commonly involved medications by justification for intervention.

Table IV: Medications by Justification for Intervention

Intervention Justification Type	Medications Involved
Duplicate Therapy	proton pump inhibitor + histamine-2 antagonist; bronchodilators; beta-antagonists
No Indication	antidepressants; antihistamines
Cost Savings	antibiotics; HMG CoA-reductase inhibitors
Improved Safety	digoxin; beta-antagonists; antibiotics; HMG CoA-reductase inhibitors; bronchodilators
Morbidity or Mortality Benefit	HMG CoA-reductase inhibitors; angiotensin converting enzyme inhibitors; beta-antagonists
Patient Not Meeting a Goal	HMG CoA-reductase inhibitors, fish oil, insulin, warfarin
Renal/Liver Adjustment	Antibiotics, low molecular weight heparin, fibric acid derivatives
Drug-Drug Interaction	HMG CoA-reductase inhibitors + antiarrhythmics, proton pump inhibitors + P2Y12 inhibitors; antibiotics + antiarrhythmics

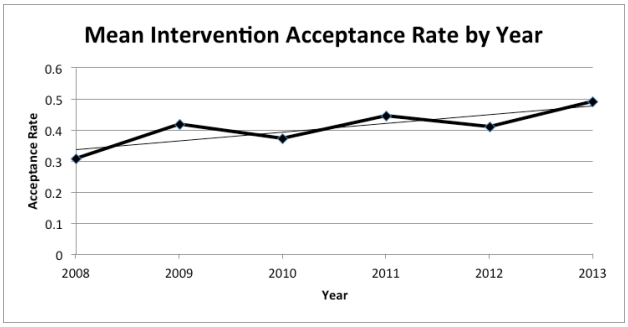
As the academic years progressed, the mean intervention acceptance rate also increased (Figure 1). There was a statistically significant increase in the probability of acceptance as the academic year progressed (p=0.0118).

Figure 1: Mean Acceptance Rate by Year



Likewise, Figure 2 demonstrates that as the years progressed from 2008 through 2013, there was an increase in the mean annual acceptance rate for the practice site which was statistically significant (p=0.0118) (Figure 2).

Figure 2: Mean Acceptance Rate Trend from 2008-2013



Discussion

This study is the first, to our knowledge, to report pharmacy student intervention acceptance for a cardiology rotation and is also one of few studies to report written intervention acceptance rates. Likewise, the analysis included more students and covered a longer time period than previous reports (Table I). In this study, between 2008 and 2013, the mean student intervention acceptance rate was 40.5%. The mean acceptance rate was highest in the year 2013 (49%) and also highest at the last rotation at end of each academic school year (49%). While this rate is low compared to other studies where the students round with the prescribers (Table I), it is similar to the only study that reported intervention acceptance for an inpatient rotation with written interventions (54.2%) (Pound & Miller, 2007).

The slightly higher acceptance rate reported by Pound & Miller may be due to the fact that their study was conducted at a community teaching hospital and some of the interventions were addressed to resident physicians (Pound & Miller, 2007). At our non-academic institution, all interventions were addressed to attending cardiologists, cardiology mid-level providers, or hospitalists. This supports a published review stating that prescribers that are older or have higher "status" tend to show lower favourability towards pharmacist intervention (Klopfer, 1990). Furthermore, the students may not have even met the provider that they left the note for.

This study affirms, that when compared to institutions where pharmacy students round with the prescriber, written interventions have a much lower acceptance rate. Pound & Miller offered several explanations for this. One was the dependence on the limited information in the medical record (Pound & Miller, 2007). When students are not communicating face to face with other prescribers, they are relying on the medical record to determine the appropriateness of an intervention. Another explanation was the time delay between the intervention and prescriber rounding. Unless urgent, at our site, students typically leave written interventions in the chart after the prescribers have rounded that morning (Pound & Miller, 2007). They are typically not addressed until later that afternoon or the following day, depending on the patient's status.

These findings are consistent with previous literature reporting factors influencing acceptance rates of pharmacist interventions (Klopfer, 1990). Such considerations include the timing of the intervention (while the prescriber is on the floor versus not present), method of communication, solicited versus unsolicited recommendation, type of prescriber (position or status), and type of pharmacist (Klopfer, 1990). Factors leading to non-acceptance of pharmacist interventions include lack of prescriber awareness, poor quality of suggestions, prescribers' exercise of caution with respect to patient safety and well-being, lack of pharmacist preceptor screening, and negative attitude toward clinical pharmacists (Slaughter, 1994; Klopfer, 1990). One study demonstrated that pharmacist interventions had the highest acceptance rates during direct personal communication (100%), versus indirect communication through a nurse (61%), versus written (33%) (Greenlaw, 1977). Finally, DiVall *et al.* also found that rejection rates were higher in the general medicine setting (10.3%) when compared to ambulatory (1%) and community settings (2.8%), $p<0.01$ (DiVall, 2010).

The fact that the acceptance rates increased as the academic year progressed may be best explained by the fact that students gain experience throughout the year and have a better understanding of what interventions are clinically important and commonly accepted by providers. Anecdotally, preceptors report that pharmacy students will generate a multitude of interventions as they begin clinical rotations that are not clinically relevant. These are often "filtered" by the preceptor before being conveyed to the providers. As the year progresses, the number of clinically irrelevant interventions seems to decrease. That said, there was still no significant correlation between the number of interventions per student and acceptance rate.

Intervention categories with the highest acceptance rates at this site included class change and administration time changes, 55% and 53%, respectively. While there was no one intervention that predominated the class change category, most of them involved a major safety issue such as drugs that prolonged the QT interval. The higher acceptance rate for administration time changes is also not unexpected as at this institution, as pharmacists often have the authority through policies and procedures to change the administration time of certain medications without provider consultation.

Justifications with the highest acceptance rates were duplicate therapy and no indication, 73% and 50% acceptance rates, respectively. These types of interventions often involve medication errors, originating from the home medication list or a transfer from a different institution. In the cardiac unit at this institution, staff pharmacists are increasingly more involved in both admission and discharge medication reconciliation. Therefore, the higher acceptance rates for these justifications may be due to the fact that providers have been primed to promptly address them through pharmacy interventions upon admission medication reconciliation.

Another interesting finding from this study is the fact that as the years progressed from 2008 through 2013, there was an increase in the mean annual acceptance rate. The inpatient cardiology site has been in existence since 1996 with the current faculty preceptor in her position starting in 2007. It is possible that the increase in provider acceptance over the years is due to the preceptor "learning curve", *i.e.* learning over time which interventions providers at the site are more likely to value. The trend may also be due to improved rapport between the pharmacy preceptor and providers.

As the role of the clinical pharmacist continues to evolve and expand, so does the emphasis on inter-professional collaboration. This is evident by the publication of the Core Competencies for Inter-professional Collaborative Practice and the recent emphasis of inter-professional collaboration in the 2013 CAPE Educational Outcomes (American Association of Colleges of Pharmacy, 2013; Inter-professional Education Collaborative Expert Panel, 2011).

The changing face of healthcare also demands more face to face interaction between pharmacists and prescribers to improve Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, reduce readmissions, facilitate prescriber computer order entry (PCOE), achieve core measures, optimise patient outcomes and secure adequate reimbursement. In fact, since completion of this study, changes at this institution have already been implemented to integrate more multidisciplinary collaboration in the cardiac unit and expand the role of the clinical pharmacist. This is expected to increase even more in the future.

Limitations

There are several limitations of this study that should be mentioned. First, data was only collected from one site which may limit the generalizability of the results. Institution-specific policies and procedures related to pharmacy interventions such as authority to dose and adjust certain medications and to complete drug product substitution without prescriber approval could impact this. Furthermore, the fact that this site was private and non-academic and only involved one pharmacy preceptor who worked Monday through Friday also limits generalizability. Because of this, the study did not include any pharmacy interventions made by the staff pharmacist who conducted admission medication reconciliation. Therefore, there may be an underrepresentation of interventions involving medication reconciliation. Finally, the study was also retrospective and non-randomised. Therefore, interventions that were of critical importance were communicated by either immediate face to face or telephone interaction with the providers. These oral interventions, though infrequent, were not included in the study. Because of their clinical significance, these interventions were almost always accepted and may have also slightly increased the overall student acceptance rate if included. Thus, the slightly lower acceptance rate in this study as compared to Pound & Miller may also be explained by the fact that our study did not include oral provider interventions of any kind (Pound & Miller, 2007).

Conclusion

An important part of the collaboration between pharmacy students and the health care team is the ability to make therapeutic recommendations to other providers that will positively impact patient outcomes. This study showed that as experience was gained through the academic year, written student interventions were more likely to be accepted by providers. Despite this, acceptance rates were still low when compared to institutions where pharmacy students round with the provider.

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