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## Cost Analysis of a Pharmacy Intern Program at a Tertiary Academic Medical Center

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Cost Analysis of a Pharmacy Intern Program at a Tertiary Academic Medical Center

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Capstone 2014

## Table of Contents

- I. Executive Summary
- II. Background
  - a. Problem Statement
  - b. Literature Review
- III. Research Design
- IV. Results
- V. Discussion
- VI. Conclusions
- VII. Citations

## I. Executive Summary

In the modern world of healthcare, the role of the pharmacy intern is growing as hospitals look to decrease cost and increase care. The University of Kentucky Pharmacy Intern Program (UKPIP) employs pharmacy interns as pharmacist extenders to help complete the clinical task of medication reconciliation (med recs). The purpose of this study was to quantify the value of completing this task and determine whether it is cost effective to have interns or pharmacists in this role.

The Institutional Review Board approved this study. UK's electronic medical record database identified admission med recs completed by pharmacy interns and pharmacists in two different study periods. Each document was evaluated and a complexity scale was used to assign a value to each med rec utilizing a multiplication factor for those with higher numbers of home medications and those where additional research was required to obtain information, such as calling a pharmacy. Each complexity factor was multiplied by an hourly salary value for either an intern or a pharmacist to determine the cost of that med rec.

Since the initiation of the pharmacy intern program, the number of daily med recs completed by pharmacists has significantly decreased and the number of med recs completed overall has significantly increased. Interns are completing med recs on more complex patients and are more likely to document their sources of information than pharmacists, a potential quality indicator. These results are skewed by the institution of a policy to complete a med rec within 24 hours of admission between the time of the control and study groups. By comparing admission data, it was determined that the daily admissions were not significantly different between groups. Therefore, extrapolating the med recs that pharmacists would have potentially completed in the control group, with the same policy in place, leads to a cost savings of about 62% of funds previously allocated to med recs.

At this time, the UKPIP is cost effective for the hospital. Interns have decreased the burden of work on pharmacists in a cost effective manner and there are indications that interns are completing quality work with value. Expanding the clinical role to similar tasks may be an appropriate next step for pharmacy interns.

## II. Background: Problem Statement

The Pharmacy Practice Model Initiative (PPMI) was developed by the American Society of Health-Systems Pharmacists (ASHP) to standardize and develop a practice model. This initiative addresses the major areas of pharmacy including roles for the pharmacist and technician as well as automation in delivering patient care. Unfortunately, it does not address the role of the student pharmacy intern. Student pharmacy interns can legally complete professional activities, such as patient counseling, and technical responsibilities, such as counting pills, with supervision.

This broad scope of practice takes on different forms at hospital sites through intern programs. The main role published in current literature is to use interns as clinical extenders to complete initial patient interviews, called admission medication reconciliation (med recs). The process involves interviewing a patient to obtain information about the medications they take, clarifying this information with a second source and then discussing the information with the primary care team to resume necessary home medications.

The main problem with this model is that it has not been financially justified. Intern programs are funded through hospitals based on traditional beliefs such as interns completing technical tasks and pharmacists' obligation to train their successors. In this way, administrators have a sense that interns do not cost as much as pharmacists. However, there is no literature studying the financial impact of having interns complete med recs.

Another issue with the role of the pharmacy intern is that the role changes at each practice site. The current literature shows that academic medical centers may benefit financially from med recs being completed by interns but smaller hospitals may need to rely on a different task for interns or a more diverse role.<sup>6</sup> This Capstone will focus solely on med recs and then explore ideas for different sites.

As the healthcare system evolves, the model of hospital pharmacy is expected to expand to help hospitals save money by providing optimal medication management. Since interns could complete some of the more time consuming and basic clinical tasks, which would free up the pharmacists' time, their role could become more important. By showing that current models are either financially responsible or detrimental would be a benefit to bolstering existing programs, encouraging the development of new programs or refocusing efforts on more cost efficient endeavors.

The problem addressed by this Capstone is the financial implications of an intern program completing med recs. This was accomplished by conducting an extensive literature review of current intern program models and by utilizing the University of Kentucky Pharmacy Intern Program (UKPIP) as a case analysis. The goal of this Capstone is to provide an example of an effective, or ineffective, use of interns as clinical extenders and to determine whether that is financially feasible and in line with current literature.

## II. Background: Literature Review

The variability of the job responsibilities of student pharmacy interns (interns) has been published throughout the history of pharmacy. Recently, the American Society of Health-Systems Pharmacists (ASHP) described the ideal practice model through their Pharmacy Practice Model Initiative (PPMI). The Consensus statement released after the initial Summit focuses on the optimal role of pharmacists and technicians. However, it does not exclusively mention the optimal role for students.<sup>1</sup>

Students are only noted in a few places in the Consensus statement. Specifically, interns are mentioned in 3 of the 147 consensus points. The first mention states that every pharmacy department should plan to have interns participate in drug therapy management services. The next mention is that training interns on the role of safety and quality in medication use is critical in implementing optimal practice models. Finally, the last mention is that it is necessary that training for interns be done on transitions of care.<sup>1</sup> The major gap that this Consensus statement leaves is what types of activities or what types of training fulfill these goals and how to allocate money to complete training. Additional literature described below illustrates that hospitals are identifying med recs as an appropriate activity, but there is little data expanding on the financial impact of interns.

There are two types of interns, experiential and employed. The difference between these distinctions is that employed interns are paid for their time and work in addition to their curricular responsibilities, while experiential interns are free to the health system and are only completing those experiential responsibilities. In

essence, every pharmacy student will complete required experiential internships but only some choose to have additional employed internships. Since experiential internships are more common, most research has focused on this role while minimal research has been published on the role of employed interns in a health system<sup>3-6</sup>.

In the state of Kentucky, internship credit can take the form of required academic experiential internships, employed internships or research related to the practice of pharmacy. Interns are allowed to complete both professional and practical pharmacy operations, such as filling medication orders or participating on patient care teams. First year pharmacy students must operate under direct supervision of a pharmacist preceptor, or a pharmacist who is registered to supervise interns by each state's respective Board of Pharmacy. From then on, the intern can operate under general supervision of a preceptor.<sup>2</sup> Again, this leaves a wide variety of roles for the intern to fill, whether employed or experiential.

Studies of experiential student contributions are mainly focused on discovering what types of interventions are made, perceptions of health care providers and contributions to recruitment. Two studies specifically addressed perceptions of health care providers who worked with interns. A study conducted at Mercer University Southern School of Pharmacy in Atlanta assessed the benefits of having pharmacy students on site at local hospitals. They achieved an 84% response rate and 79% of those hospitals reported that they felt the overall benefits of the educational affiliation outweighed any costs.<sup>3</sup> Another study conducted in Massachusetts at four major medical centers surveyed health care providers who



interacted with experiential students on a general medicine service. The majority of providers felt that student involvement was beneficial to patient care and that patient care recommendations were appropriate and accurate.<sup>4</sup>

Two further studies addressed types of interventions and contributions to recruitment. Delgado et al evaluated how the Cleveland Clinic in Florida utilizes their experiential students. Authors found that clinical interventions performed by students include med recs, disease state education, and discharge education. They also found that by having students, they were able to increase their clinical coverage to all patients in their hospital, in accordance with a PPMI goal, and to increase their residency recruitment opportunities<sup>5</sup>. Another case study evaluated students in a hospital in Ohio specifically tasked with obtaining admission medication data in an emergency department. While the service was successful, the hospital was unable to provide the service year round as the access to pharmacy students on experiential rotations was not consistent.<sup>6</sup>

These studies show that students have an effective role while completing clinical tasks in a hospital and that healthcare providers are open to their participation. The success of students in these studies indicates that employed interns could perform similarly. Bond et al further supported this implication in a study published in 2000.

Bond identified clinical pharmacy services associated with lower cost of care including admission drug histories. Further, he found that as the number of clinical pharmacists employed increased, the overall cost of care decreased.<sup>7</sup> This indicates

that using pharmacy interns as clinical extenders may provide value for a health system.

A meta-analysis published in 2012 revealed 29 articles and 9 abstracts evaluating intern interventions in multiple care settings. Interns in inpatient settings provided an average number of recommendations per week of 3.6 per intern with acceptance rates of 39-98% from health care providers. The cost savings associated with these student recommendations ranged from \$3,900 to \$128,000 per year or \$500 to \$6,000 per student per year. The literature review identified three articles showing that students are effective at completing medication histories.<sup>8</sup> This publication indicates that there are cost savings associated with pharmacy students completing clinical interventions, further supporting the idea of the possibility of effective employed interns, and suggests that medication histories may be an appropriate clinical task for interns to complete.

In the PPMI Consensus statement, a key assumption noted is that pharmacy departments need to focus on becoming more efficient. One way the PPMI suggests to do so is to make med recs an integral part of optimal care.<sup>1</sup> The Joint Commission included med recs as part of its National Patient Safety Goals (NSPG) of 2014.<sup>9</sup> A survey of pharmacists participating in admission and discharge med recs at Vanderbilt University Hospital and Brigham Women's Hospital reported that they felt med recs were the most important part of their job and also the most time consuming. They reported having an intermediary to triage initial med recs and identify patients that need additional pharmacist attention was essential to the pharmacists' job.<sup>10</sup>

This trend in health care to emphasize the importance of med recs has led to multiple attempts at relieving the pharmacist burden of completing an overwhelming amount of clinical tasks. Some hospitals employ pharmacy technicians while others have seen a natural role for an intern. A case study completed by Hall et al reported a hospital utilizing both technicians and interns to complete med recs. The technicians and interns reviewed initial lists collected by nurses, reconciled them with the patient care team, and identified critical medications for pharmacists to review. Wages, other duties and cost avoidance or savings were not reported although pharmacists did report increased satisfaction with their work.<sup>11</sup>

At this point in healthcare, literature suggests different sites have adopted a variety of intern programs attempting to decrease pharmacist burden. One such site includes Froedtert Hospital where interns are recruited to work evening and weekend shifts. The program is tiered so that less experienced interns are performing distributive tasks while more experienced interns are focused on clinical tasks including intravenous to oral medication switches, admission and discharge reconciliation, profile reviews, renal dosing and training new interns. Pharmacists traditionally completed these tasks. The study reports the intern program costs approximately \$135,000 per year and is allocated 4 Full Time Equivalents.<sup>12</sup>

Other studies have also shown success with interns in tiered programs with salary increases per tier completing similar tasks as Froedtert interns.<sup>13,14</sup> A survey conducted at hospitals in New York found that 47% of respondents reported

employing interns and 73% reported interns performing at least one clinical activity. Trends were found towards higher clinical interventions in hospitals without minimum work requirements and hospitals with greater than four hundred beds. No differences were found between teaching and nonteaching hospitals.<sup>15</sup>

Unfortunately, the cost of employing an intern to complete the supported tasks described above has not been effectively addressed. Two studies attempted to quantify an intern's financial impact but are not externally valid. The first was the previously mentioned study by Bond who found that the total cost of care in hospitals that provide admission drug histories decreased by \$6,964,788 per year.<sup>7</sup> The second, a study by Campbell et al, identified 320 clinical interventions completed by 15 experiential interns in one year at a psychiatric hospital. It estimated the cost avoidance using a resource called Rx Medi-Trend and by averaging literature estimates. Both systems calculate cost avoidance based on the probability of avoiding an adverse drug reaction if the intervention was not completed.<sup>16</sup> While both studies describe financial savings, they did not look directly at the cost of interventions but at potential cost savings using theoretical models.

The overall results of this literature review indicate that interns can successfully complete clinical interventions with health care provider acceptance, particularly med recs. There is limited data on the cost savings provided by having interns complete med recs versus the traditional model of pharmacists completing them. Therefore, the main research question addressed by this Capstone will be whether or not an intern completing med recs is more cost effective than a pharmacist performing the same task.

### III. Research Design

#### **Problem Statement:**

The role of the intern in the pharmacy practice model is not well defined. Multiple hospitals have instituted a hybrid pharmacy intern program where interns complete both clinical and technical tasks. The main clinical task identified through a literature search was med recs. A way to decide if this is cost effective outside of intangible benefits has not been established.

At the University of Kentucky (UK), the UKPIP completes med recs in the evening and on weekends as clinical extenders- a task that was traditionally completed by pharmacists. UK also has a policy that states every patient admitted must have a documented attempted med rec within 24 hours. This site will be used as a case study.

#### **Research question:**

Is it cost effective for UKPIP interns to complete admission med recs instead of completion of this task by pharmacists?

#### **Objectives:**

1. Identify the number of med recs completed by pharmacy interns and pharmacists in the study periods
2. Calculate interns' and pharmacists' compliance with policy
3. Calculate the complexity of the med recs using the scale attached
4. Calculate the cost associated with completing the med recs adjusted for complexity
5. Compare the admission data for the two study periods

**Hypothesis:**

Interns complete more med recs, are more compliant with policy and cost less than pharmacists.

**Level of analysis:**

Pharmacists and interns at the University of Kentucky Chandler Medical Center that work in the evenings and on weekends.

**Sources of data:**

- A database report from Chandler Medical Center Pharmacy Department including pharmacist med recs completed from September 20, 2011-December 31, 2011 prior to the initiation of the UKPIP and after the requirement for med recs to be completed electronically. A database report for pharmacists from September 20, 2012-December 31, 2012 as well as pharmacy interns in the same time period including med recs completed.
- A database developed by the Principle Investigator assessing individual med recs completed in the above report looking at the number of medications on each report, the source of information and whether or not it was completed in compliance with policy.
- The IRB approved the research allowing access to patient charts for this analysis as well as the database reports per IRB Protocol 13-0899.
- Daily census and new admission data from Chandler Medical Center's financial office.

## **Research design:**

Retrospective comparative financial analysis

## **Data Analysis**

### **Objective 1: Identify the number of med recs completed by each group**

- An Excel command “Count” will be used to determine the number completed per day in each study group
- Student t-test analyses will be run to determine if there has been a change in the number of med recs completed daily before and after the interns took responsibility for med recs

### **Objective 2: Calculate compliance with policy of interns and pharmacists**

- In the database, each med rec will be assigned a value of 1, 2 or 3 in accordance with compliance with policy. A ‘1’ indicates it was completed within 24 hours, ‘2’ 24-48 hours, and ‘3’ >48 hours.
- Average compliance values will be calculated by dividing the number of med recs assigned ‘1’ by the total number of med recs per study group
- The Chi-Square Goodness of Fit test will be used to evaluate each sample. Expected observations will be 100% for ‘1’ and 0% for ‘2’ and ‘3’.

### **Objective 3: Calculate the complexity of the med recs**

- Each med rec will be assessed for number of drugs and source of information. They will be assigned a complexity factor as shown in the following tables.

<b>Number of drugs</b>	<b>Complexity factor</b>
< 5	0.5
5 - 10	1
11 - 15	1.5
> 16	2

<b>Source of information</b>	<b>Complexity factor</b>
Patient	0
Family/caregiver	0
Clinical record	0.25
Pharmacy	0.5

- The total complexity factor is equal to the sum of the complexity factor for the number of drugs and the source of information.
- These factors were determined by assessing an initial 500 med recs showing the average med rec has between 5-10 medications. This was assigned complexity factor of 1, or no change in cost besides the time associated with the interview, because it represents the average med rec. The most common sources of information in the pre-study group were patient and family or caregiver, which would add no additional time to an interview so no additional complexity. The other variables were given arbitrary increases in complexity that would cancel, as they are held constant across all groups. For example, it would take more time to reconcile more drugs and it takes more time to contact a pharmacy than to consult a clinical record so they received a higher complexity.
- Student's t-tests will be used to assess whether the daily mean complexity factor is the same between the 2011 pharmacist med recs and 2012 combined



pharmacist and intern med recs as well as 2011 pharmacist med recs and 2012 intern med recs alone.

**Objective 4: Calculate the cost associated with completing the med recs**

- Each med rec will be assigned a cost using the following formula: cost per med rec is equal to cost for complexity factor of '1' multiplied by the total complexity factor for that med rec.
- The cost for a complexity factor of '1' was calculated using the table below.

<b>Table 3. Cost for a complexity factor of 1.</b>			
	<b>Average time for 1 med rec</b>	<b>Average hourly wage</b>	<b>Cost for complexity factor of 1</b>
<b>Intern</b>	20 mins / 0.33 hr	\$13.18	\$4.35
<b>Pharmacist</b>	20 mins / 0.33 hr	\$46.34	\$15.29
Source: 2013-2014 University of Kentucky salaries			

- The average time for a med rec was determined based on personal experience and consultation with current interns and will cancel out as it is held constant across groups. The average hourly wage was calculated by averaging the wages of the interns and the wages of the clinical pharmacists who work similar shifts. The cost for a complexity factor of '1' was calculated by multiplying the average hourly wage by the average time it takes to complete one med rec.
- Final analysis will look at percentage of cost changes between groups rather than concrete numbers as some of the variables, such as average time, may not be accurate in terms of hard dollar changes but will not affect percent changes.

### **Objective 5: Compare admission data for the two study periods**

- The policy to complete a med rec within 24 hours of a patient's admission began early in 2012. This coincides with the interns starting to complete the bulk of admission med recs.
- Daily admission data was obtained for both study periods. Student's t-test will be used to determine if the number of admitted patients were similar in each time period.
- The hypothesis is that the admission data will not be significantly different. Therefore, the number of admission med recs that would have been completed by pharmacists in 2011, if the policy had existed, will be obtained by extrapolating from the 2012 data.

#### IV. Results

##### **Objective 1: Identify the number of med recs completed by each group**

The number of med recs were grouped by day since each study group was for the same amount of time. The total count is recorded in Table 3 and the results of the t-test are recorded in Table 4. These results show that interns were completing significantly more med recs per day in 2012 (mean diff 13.4,  $p < 0.05$ ) and that pharmacists in 2012 were completing significantly fewer med recs per day when compared with the control group of med recs completed by pharmacists in 2011 (mean diff -2.3,  $p < 0.05$ ). This is important because the goal of the intern program was to decrease the number of med recs completed by pharmacists, which was accomplished despite a significantly lower amount of med recs completed by pharmacists in 2011, accounted for by a policy change discussed below.

Pharmacist 2011	388
Intern 2012	1623
Pharmacist 2012	149

	<b>P-value</b>	<b>Mean number of med recs per day</b>	<b>95% Confidence Interval</b>	<b>Difference</b>
Total 2012	<0.001	17.2	16.1-18.3	13.4
Pharmacist 2011		3.8	3.2-4.4	
Pharmacist 2012	<0.001	1.4	98-1.9	-2.3
Pharmacist 2011		3.8	3.2-4.4	
Intern 2012	<0.001	15.8	14.7-16.8	12.0
Pharmacist 2011		3.8	3.2-4.4	

### **Objective 2: Calculate compliance with policy of interns and pharmacists**

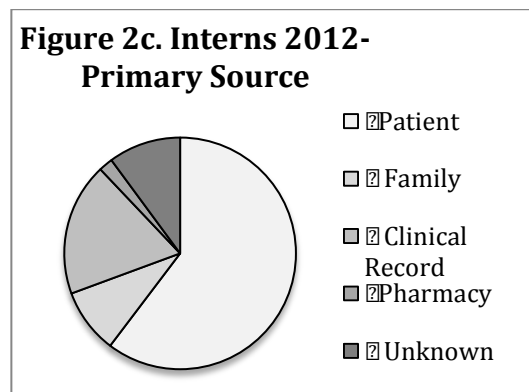
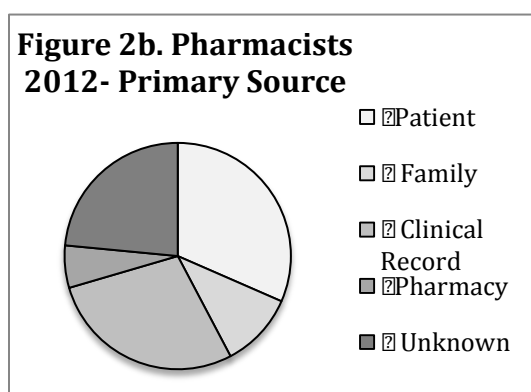
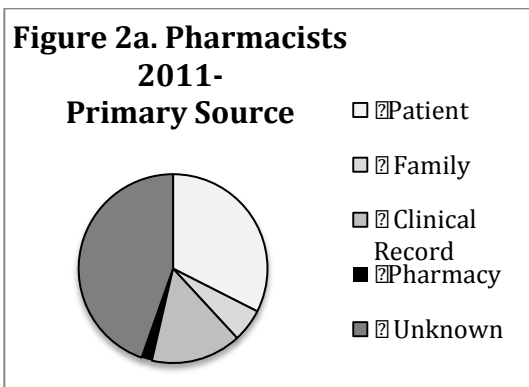
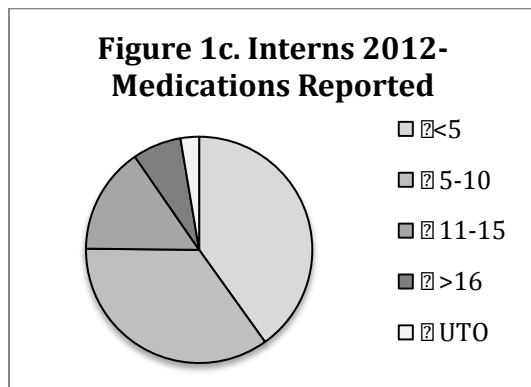
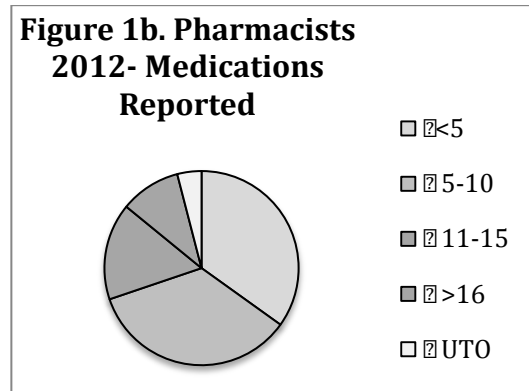
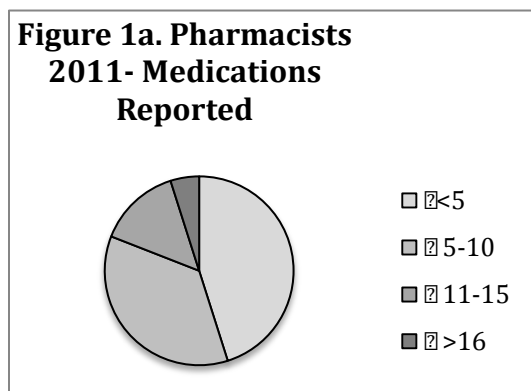
Chi-square goodness of fit test was used to determine if compliance with policy differed significantly from expected compliance. Table 6 shows the results. The expected compliance with policy was 100%. As shown, the study groups in 2012 were able to achieve this compliance as illustrated with small chi-square variables and p-values showing the results of the 2012 study groups are not significantly different from the expected results. It is important to note that the policy that states each patient must have a med rec completed within 24 hours of admission was instituted between the 2011 and 2012 study groups. Therefore, the resultant high chi-square variable and p-value less than 0.05 associated with the pharmacist study group in 2011 is not surprising and represents a major limitation of this study.

	<b>Frequencies of observation</b>		<b>Chi-square variable</b>	<b>p-value</b>
Pharmacist 2011	1	330	8.67	0.0131
	2	34		
	3	24		
Intern 2012	1	1,576	0.85	0.6527
	2	32		
	3	15		
Pharmacist 2012	1	143	0.24	0.8862
	2	5		
	3	1		

### **Objective 3: Calculate the complexity of the med recs**

The complexity of each med rec was calculated using the scale described in the Research Design section above. Figure 1a-1c represent the proportion of med recs assigned to each medication number category while Figure 2a-2c represent the proportion of sources utilized by each study group. As the graphics show, each

group recorded similar numbers of medications in each med rec. However, the interns were much more likely to utilize the patient as their primary source and much more likely to document their source. Pharmacists in 2011 show undocumented sources almost 50% of the time and pharmacists in 2012 improve, but still show undocumented sources around 25% of the time. This is a quality indicator for the intern study group.



The final complexity factor for each day was determined by averaging the complexity factor of all patients in each study group for each day. As shown in Table 7, pharmacists in 2012 were completing med recs equally as complex as patients reached by pharmacists in 2011. However, it also shows interns in 2012 were completing significantly more complex patients than pharmacists in 2011. This could also be due to the interns more complete documentation of sources, which allow for a more accurate estimation of cost. The increased complexity is important because, per the developed scale, this means the interns in 2012 were completing more expensive med recs. This is preferred as interns are paid less per hour and it allows pharmacists to complete other clinical tasks that require a higher level of understanding and are more cost appropriate for pharmacists' wages.

<b>Table 7. Student's t-tests for significance of complexity factor (CF).</b>				
	<b>P-value</b>	<b>Mean CF per day</b>	<b>95% Confidence Interval</b>	<b>Difference</b>
Total 2012	0.85	0.86	0.79-0.93	-0.011
Pharmacist 2011		0.87	0.78-0.96	
Intern 2012	<0.001	1.17	1.13-1.20	0.298
Pharmacist 2011		0.87	0.78-0.96	

**Objective 4: Calculate the cost associated with completing the med recs**

Table 8 describes the total cost of the med recs with multiple permutations. Sources were listed as “unk” or unknown if the pharmacist or intern did not document a source as defined in Table 2. The number of medications were listed as “UTO” or unable to obtain if the pharmacist or intern was not able to speak with the patient; For example, the patient was in surgery or intubated or the patient was unable to recall their medications. These incomplete med recs could still be included as the

“unk” source med recs may still list medications and the “UTO” med recs may still list a source and could be included in the scale and associated with cost. These two limitations affect the complexity factor and therefore the overall cost so the cost was calculated including and excluding those med recs.

In terms of overall cost, pharmacists in 2011 completed \$6,215.39 worth of med recs with an average cost per med rec of \$19.13, while pharmacists in 2012 were paid \$2,656.64 for time associated with med recs at an average cost per med rec of \$19.78. Meanwhile, interns were paid \$8,220.41 to complete over 4 times as many med recs as pharmacists in 2011 with an average cost per med rec of only \$6.10.

<b>Table 8. Total cost adjusted for complexity factor.</b>						
	<b>N</b>	<b>Total cost</b>	<b>Avg cost per med rec</b>	<b>Avg cost without UTO/unk</b>	<b>Percentage unk</b>	<b>Percentage UTO</b>
Pharmacist 2011	388	\$6,215.39	\$15.98	\$19.13	44.59%	0%
Intern 2012	1623	\$8,220.41	\$5.07	\$6.10	10.1%	3.36%
Pharmacist 2012	149	\$2,656.64	\$17.83	\$19.78	23.49%	2.65%

An important conclusion to draw from this table is the percentage of unknown sources for each group as it is a potential quality indicator. Documentation of sources allows for mistakes or misinformation to be tracked and represents appropriate patient care. Shown above, interns had the lowest percentage of undocumented sources at 10%, while pharmacists in 2011 had the highest at 44.59%. Further, pharmacists in 2012 still had a rate of 24% unknown sources, indicating they have not changed their documentation habits.

### Objective 5: Compare admission data for the two study periods

Since pharmacists were not required to complete med recs within 24 hours until the beginning of 2012, the control group is limited. Evaluating the daily admissions from each study period and using a t-test to determine if they are significantly different allows for the calculation of the number of med recs that potentially would have been completed in the 2011 group if the policy were in place. This can then be used to extrapolate a general cost difference. The results of the t-test are shown in Table 9 and new cost data in Table 10.

	P-value	Mean admits per day	95% Confidence Interval	Difference
Admissions 2012	0.55	76.9	73.2-80.6	1.6
Admissions 2011		75.3	71.5-79.1	

	Current Cost	Extrapolated Cost	Percent Difference
Pharmacist 2011	\$6,215.39	\$28,316.56	\$17,439.51
2012	\$10,877.05	\$10,877.05	61.59% reduction

As shown above, the admission data is not significantly different, with mean admits per day being 76.9 and 75.3 people per day in 2012 and 2011 respectively (mean diff 1.6,  $p > 0.05$ ). Therefore, the data from the total number of med recs completed in 2012 could be used to extrapolate an equivalent number of potential patients for pharmacists in 2011 using the total number of med recs performed in 2012 multiplied by the average cost per med rec from 2011. This assumption means that if pharmacists in 2011 had completed med recs on every patient within 24 hours of



admission, the hospital would have paid them approximately \$28,000. That is a 62% increase in cost from what was associated with med recs in 2012.

## V. Discussion

Pharmacy interns are thought to bring value to a hospital for a lot of different reasons. This Capstone evaluated whether pharmacy interns can potentially save hospitals money by completing clinical tasks traditionally completed by pharmacists.

Results shown above are generally positive for interns and show potential cost reductions. However, there are a few limitations to be noted.

There are a multitude of variables that affect the med recs completed by the UKPIP and pharmacists. First, the institution of new policy and availability of electronic medical records that make it easier to document admission med recs. The next variable in med recs is daily census data and number of new admissions. Another variable is the trust bestowed upon the pharmacist or intern to allow them to complete med recs. This increases as a service is established. Finally, the complexity of the patient population is variable and affects the time taken to complete a med rec and ultimately the cost.

This study attempted to control for these things by utilizing study periods after establishment of electronic medical records. Unfortunately, it was unable to standardize to policy, but with equal daily admissions, conclusions can still be made by extrapolating data. The study period is at a time when the UKPIP was already established and entrusted with full responsibility for med recs during their shifts. Daily census and admission data were taken into account during analysis to standardize data. Finally, the variability of the patient population was considered random per service covered by a pharmacist or intern (for example, surgery patients) but the complexity overall was analyzed using number of medications and

source of information to see if interns were entrusted with an equally complex patient population. Of note, interns and pharmacists in this study worked the same shifts and served the same patient population.

The external validity of this study presents multiple problems. Since it is a singular case study, it is difficult to apply results to locations other than the University of Kentucky. However, the majority of hybrid intern programs currently exist at tertiary academic medical centers with interns completing med recs so the results will probably be externally valid at those locations. There will not be external validity at small, community hospitals or places without electronic medical records. The general assumptions made about interns in practice models and potential roles for them are externally valid because the concepts can be adopted with variations for actual tasks completed based on the needs of different practice sites. The main objective for external validity was to show there is a cost effective role for interns and each site needs to identify what task completion will show similar cost effectiveness for them.

This study is unique in its design as it attempted to identify the specific cost associated with completing one specific clinical task. However, this makes it difficult to assess since there are not preceding studies to compare. The positive results presented should be interpreted carefully, keeping in mind the maturity of the financial calculations applied.

## VI. Conclusions

Overall, this study shows that completing med recs is an appropriate task for an intern program at a tertiary academic medical center. Interns in the UKPIP were able to perform the bulk of med recs at the hospital, document appropriately and reduce the workload for pharmacists.

These results show that interns are completing quality interventions by traditional standards such as documenting work and thoroughly investigating patient profiles. Pharmacists are completing fewer med recs, which was the goal of the intern program. Interns are reaching patients who are more complex and require a more time-consuming interview, as well as completing further investigation with pharmacies and clinical records to verify the patients' medication profiles. This means that they are freeing up time for pharmacists to complete other tasks to contribute to patient care.

The financial implications of this study are positive. Using the scale developed by the Principle Investigator, the interns present a possible cost reduction of 60% of cost associated with one clinical task. If other clinical tasks prove equally as beneficial, programs could potentially pay for themselves and then some.

However, future research can be completed to improve on this study. First, a prospective study to validate the scale developed here would be beneficial. Next, evaluating quality indicators to determine if interns' work is equivalent to pharmacists' work. Finally, a more complete cost analysis could be completed

including all clinical and technical tasks completed by the intern program as well as the cost to train and educate interns.

In conclusion, this retrospective comparative analysis is in line with current literature as it supports the completion of med recs by interns. Further, it illustrates concretely, for the first time, that interns are financially beneficial as well. Overall, it supports the institution of interns as clinical extenders for hospital pharmacists.

## VII. Citations

1. PPMI Summit. "The Consensus of the Pharmacy Practice Model Summit." *Am J Health-Syst Pharm*. 2011;68:1148-52.
2. 201 KAR 2:040. Registration of pharmacist interns.
3. Anderson RJ. "Assessment of clinical service contracts between hospital pharmacies and colleges of pharmacy." *Hosp Pharm* 1992;27:499,503-7.
4. Lancaster JW, Douglass MA, Gonyeau MJ, Wong A, Woolley AB, DiVall MV. "Providers' perceptions of student pharmacists on inpatient general medicine practice experiences." *Am J Pharm Educ*. 2013;77(2): Article 26.
5. Delgado, Osmel. Risken, Jaime. Zapantis, Antonia. "Extending Students' Pharmacy Practice Experiences into Patient-Care Areas." *Pharmacy Practice Model Initiative Case Study*.
6. Taylor, Rebecca. "Pilot Medication Admission History Services in Academic Medical Center ED Using APPE Students." *Pharmacy Practice Model Initiative Case Study*.
7. Bond CA, Raehl CL, Franke T. "Clinical pharmacy services, pharmacy staffing, and the total cost of care in United States hospitals." *Pharmacotherapy*. 2000;20:609-21. DOI 10.1592/phoc.20.7.609.35169.
8. Mersefelder TL, Bouthillier MJ. "Value of the student pharmacist to experiential practice sites: a review of the literature." *Ann Pharmacother*. 2012 Apr;46(4):541-8.

9. The Joint Commission. "Hospital National Patient Safety Goals 2014." Web. 10 Feb 2014.  
<[http://www.jointcommission.org/assets/1/6/HAP\\_NPSG\\_Chapter\\_2014.pdf](http://www.jointcommission.org/assets/1/6/HAP_NPSG_Chapter_2014.pdf)>
10. Haynes KT, Oberne A, Cawthon C, Kripalani S. "Pharmacists' recommendations to improve care transitions." *Ann Pharmacother*. 2012 Sep;46(9): 1152-9.
11. Hall, Scott. "Medication Reconciliation by Pharmacy Technicians, Student Interns." *Pharmacy Practice Model Initiative Case Study*.
12. Karpinski, Todd. "Expansion and Restructuring of Hospital Pharmacy Internship Program." *Pharmacy Practice Model Initiative Case Study*.
13. Skledar SJ, Martinelli B, Wasicek K, Mark S, Weber RJ. "Training and recruiting future pharmacists through a hospital-based student internship program." *Am J Health Syst Pharm*. 2009 Sep 1;66(17):1560-4.
14. Bair JN, Powell PJ. "Structured competency-based hospital pharmacy internship program." *Am J Hosp Pharm*. 1981 Nov;38(11):1705-8.
15. Nathan JP, Schilit S, Zerilli T, Shah B, Plotkin P, Tykhonova I. "Functions performed by paid pharmacy interns in hospitals in New York." *Am J Health Syst Pharm*. 2011 Jan 15;68(2):165-8.
16. 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;75:1-7. DOI aj75018.pdf.