Impact of a Training Program on Pharmacists' Comfort With Pediatric Pharmacy Concepts and Basic Pediatric Knowledge

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ABSTRACT

Objective: To determine the impact of a training program on pharmacists' comfort with pediatric pharmacy concepts and basic pediatric knowledge.

Methods: All pharmacists at our institution were invited to participate in the study. Consenting participants completed a baseline survey of 15 questions on basic knowledge in 5 pediatric topic areas (pharmacokinetics/pharmacodynamics, weight-based dosing, anticoagulation, renal dosing, and common antibiotics) as well as 8 statements rating self-reported comfort with pediatric pharmacy. Following the pretraining survey, a training program combining self-study of handouts on the 5 topics with optional attendance at live education sessions was completed. Participants then completed a posttraining survey of the 5 topics including repeat comfort assessment. The primary outcome was change in self-assigned scores on the comfort-based assessment before and after training.

Results: Fifty-two pharmacists consented to participate. Participants reported significant improvement in 6 of 8 comfort questions after training ($p < .001$). Those without prior pediatric experience had lower comfort ratings at baseline and showed significant improvement after training for 5 of the 8 questions ($p < .001$). Significant improvement in the proportion of correct answers on the knowledge assessment occurred after training, regardless of prior experience (61% vs 89%, $p < .001$).

Conclusions: Self-study training with optional live education resulted in significant improvement in most self-reported comfort scores for pharmacists, particularly those without recent pediatric pharmacy experience. Pharmacists, regardless of experience, improved basic pediatric knowledge scores after training.

Key Words—assessments, comfort, pediatric, training program

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The Accreditation Council for Pharmacy Education (ACPE) guidelines for doctor of pharmacy degree programs emphasize that every graduating pharmacy practitioner must be prepared to provide direct patient care in a wide variety of health care settings, with the responsibility to ensure optimal therapy outcomes and safety for a wide variety of patients.^{1–3} Accordingly, ACPE supports that this ability can be achieved through the development of a strong

foundation in clinical sciences, including understanding special populations, like pediatrics, and related prescription and nonprescription pharmacotherapy, population-specific dose calculations and dose adjustments, and drug monitoring. Despite these standards, a 2005 survey of recent doctor of pharmacy graduates reported an average score of 61.5% on a pediatric competency exam, suggesting that even recent graduates may require additional training to improve

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their overall understanding of pediatrics topics and pediatric competency.⁴ A separate survey of individual pharmacists supported the statement that, in general, pharmacists should have the knowledge and expertise to make pediatric therapy recommendations. However, when those same pharmacists were asked about their personal knowledge, expertise, and comfort with making pediatric recommendations, there was discordance amongst the perceived abilities of the profession and self-perceived competence and confidence.⁵

A number of self-study and didactic training programs in various pharmacy practice areas have been successful in promoting staff development and competency amongst pharmacists.⁶⁻¹⁰ One institution developed a program to improve hospital pharmacists' drug information skills with primary instruction via a 6-topic self-study handbook.⁶ This program was well-accepted by the pharmacy staff because it incorporated personal experiences, small group activities, and flexible scheduling. The institution did not formally assess participant's improvement. Another institution with a similar training model for drug information determined through a formative assessment that self-study training was an effective means to improve utilization of drug information resources while accommodating for differences in the rate of staff development.⁷ A clinical program for pharmacists in the areas of pharmacokinetics and infectious disease compared pre- and posttraining assessments and revealed improvement in pharmacists' related clinical knowledge.⁸ A training program for pharmacists on pediatric emergencies incorporated a multimedia self-study training program with a structured objective clinical evaluation.⁹ The pharmacists participating in this program experienced both improved competency (score on 20-point examination increased by an average of 11%, $p < .001$) and confidence (scores for 4 of the 5 questions increased significantly) as a result of the training. More recently, pharmacists could voluntarily participate in an educational program in providing pediatric care at a community teaching hospital.¹⁰ Significant improvements in both confidence and competence in pediatric pharmacotherapy among health system pharmacists were seen.

These programs, while positively influencing pharmacist training, were studied on only a small number of participants. At our institution, the absence of a preexisting formal pediatric training program and a staff of nearly 80 pharmacists provided a unique opportunity to assess the impact of a pediatric training program in a larger model. This larger group of pharmacists also allowed for training of both bachelor of science and doctor of pharmacy pharmacists.

METHODS

We conducted a prospective, cohort, quasi-experimental study to determine the impact of a pediatric training program on pharmacists' comfort with pediatric pharmacy concepts and basic pediatric knowledge. The study took place at a 979-bed community-teaching hospital that includes a 71-bed children's hospital and 100-bed neonatal intensive care unit. The study was approved by all institutional review boards involved and was conducted in accordance with standards set forth by the Declaration of Helsinki. All pharmacists who were employed full-time, part-time, or per diem at the hospital were invited to participate in the study. Study investigators and those failing to provide informed consent were excluded. The primary objective of the study was to determine whether a pediatric training program impacted pharmacists' overall comfort in working with the pediatric population at our institution as assessed by evaluating changes in responses to pre- and posttraining surveys.

The study investigators developed an institution-tailored pediatric training program for pharmacists that encompassed 5 important topics in pediatric pharmacy: pharmacokinetics and pharmacodynamics, weight-based dosing, renal dosing, anticoagulation, and common antibiotics (vancomycin and aminoglycosides). The training program required pharmacist self-study of a 2-page (front and back) evidence-based handout on each of the 5 topics. The contents of the training program were released incrementally over a period of 3 weeks, with 2 topics each being covered during the first and second week and the final topic being covered in week 3. Optional live education sessions were offered one day each week during the training period. The live sessions were each 30-minutes long, covering each of the training topics released that week, and they occurred at 3 different times of day to allow pharmacists from each shift to attend.

Prior to the start of the training period, all participants were assigned a random number that was used by them when completing the pre- and posttraining online surveys. The random number served to protect each participant's identity and allowed pairing of pre- and posttraining survey responses for data assessment. Participants had 2 weeks prior to the training period and 2 weeks after the period to complete the pre- and posttraining surveys, respectively. The pre- and posttraining surveys were completed online using Survey Monkey. Participants had only one opportunity to complete each survey, and there was no time restriction for the survey attempt. Both

pre- and posttraining surveys assessed 2 domains: basic pediatric knowledge, and self-reported comfort with pediatric pharmacy concepts. Pediatric knowledge was assessed through 15 multiple-choice questions: 3 questions related to each of the 5 topics in the pediatric training program. Participants described personal comfort by rating 8 statements according to a 7-point Likert scale (Figure 1). For the pre- and posttraining surveys, the scale ranged from strongly disagree to strongly agree, respectively, and with the midpoint rating of 4 representing neutrality. In the pretraining survey, participants provided basic demographic data, including gender, pharmacy degree(s) earned, duration of time as a pharmacist, pediatric pharmacy experience in the previous 2 years, duration of pediatric pharmacy experience, whether the participant is currently raising a child younger than 18 years of age, and the number of children in the participant's care. The posttraining survey required participants to comment on compliance with the training program by identifying which self-study handouts they reviewed and/or which live education sessions they attended. Participants were also asked if they liked, neither liked nor disliked, or disliked the pediatric training program.

Outcomes

The primary outcome was the comparison of self-assigned scores on the pre- and posttraining comfort-based survey questions following the pediatric training program. Secondary outcomes included subanalysis of the primary outcome by work in a pediatric department or hospital, recent pediatric pharmacy experience, and program participation. Basic program participation required completion

of both pre- and posttraining surveys, and it was assessed as the self-study of 3 or more topic handouts and/or attendance at 3 or more live education sessions. With 5 topic handouts released for self-study and each of the 5 topics covered in live education sessions, there was opportunity to participate in up to 10 activities throughout the training period. Other outcomes assessed included comparing the proportion of correct answers on the multiple-choice knowledge assessment before and after the training program, with subanalysis by training program topic, work in a pediatric department, and reported recent pediatric experience. Recent pediatric experience was defined as pediatric specialty residency, pediatric rotation(s) during pharmacy school, pediatric rotation(s) during residency, and/or work in a pediatric department, pediatric hospital, or pediatric pharmacy satellite in the 2 years prior to the training period. Additional outcomes included the correlation between the change in self-assigned comfort scores evaluated by number of handouts reviewed, number of live sessions attended, and overall score on the knowledge-based survey after training, as well as the correlation between self-assigned comfort-based posttraining survey question scores.

Statistical Analysis

Ordinal data were analyzed using the Wilcoxon signed rank test. Continuous data were analyzed using the paired Student's *t* test, and Kendall tau correlation was used for correlation analysis. A *p* value of less than .05 was set a priori to be considered statistically significant for all comparisons. All statistical analyses were completed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY).

RESULTS

Of 75 pharmacists on staff at our institution, 59 met all inclusion and no exclusion criteria. Among eligible pharmacists, 52 pharmacists (88%) successfully completed all portions of the study, whereas the data for 7 pharmacists (12%) were deemed not suitable for evaluation due to failure to submit posttraining survey responses. A summary of the baseline characteristics can be found in Table 1.

Each of the 8 statements on the comfort-based survey was evaluated for change from baseline to completion of the training program. For statements 1-2, 4-6, and 8, an increase in median comfort rating was considered improvement because these statements were positively phrased. For statements 3 and 7, a decrease in median comfort rating was

Rated on a 7-point Likert scale (1 = <i>strongly disagree</i> , 7 = <i>strongly agree</i>)	
1.	If faced with a pediatric medication order, I am usually able to assess the appropriateness of all aspects of the order with confidence.
2.	I understand the protocols pertinent to pediatric pharmacy at Mercy Hospital St. Louis.
3.	Handling pediatric medication orders causes me anxiety.
4.	My current level of pediatric training has prepared me to address pediatric medication related questions.
5.	I have enough training in pediatrics to be able to address medication-related questions in pediatrics.
6.	Pediatric medication orders take me longer to verify than adult medication orders.
7.	Pediatric medication-related questions make me nervous.
8.	I am comfortable with my knowledge of pediatric pharmacy.

Figure 1. Comfort-based survey questions.

Table 1. Baseline characteristics^a

Participants, <i>N</i>	52
Male/Female, <i>n</i>	26/26
Degree, <i>n</i> (%)	
Bachelors of Science in Pharmacy	30 (58)
Doctor of Pharmacy	20 (38)
Both	2 (4)
Duration of pharmacist experience, median years (IQ range)	22 (5-32)
Pediatric experience in the last 2 years, <i>n</i> (%)	
Pediatric rotation (school and/or residency) ^b	5 (9.6)
Work in a pediatric hospital, pharmacy, satellite ^b	15 (28.8)
None	32 (61.5)
Duration of pediatrics experience (<i>n</i> = 20), median years (IQ range)	3.5 (2-7)

^aIQ = Interquartile.^bStudy participants included in "Duration of Pediatrics Experience" group.

considered improvement because these statements were negatively phrased (refer to **Figure 1**). Comparison of median self-assigned comfort scores for all participants (*N* = 52) before and after the training program revealed a significant improvement in responses after training to statements 1-5 and 8 ($p < .001$). The improvements in rating for statements 2, 4, 5, and 8 were also significant for a change in position from a degree of disagreement (median rating less than or equal to 4) before training to agreement (median rating greater than 4) after training (see **Figure 2**).

For those reporting recent pediatric experience (*n* = 20), no significant improvement in median rating score was observed for any of the comfort-based survey questions (see **Figure 3**). For the general staff (*n* = 32), posttraining median comfort ratings for statements 1-2, 4-5, and 8 were significantly improved from baseline ($p < .001$), and the comfort ratings for statements 2, 4, and 5 all changed from a median position of disagreement before training to agreement after training (see **Figure 4**).

Evaluation of participation in the training program revealed a significant improvement in comfort rating after training for statements 1-5 and 8 for all pharmacists reporting basic participation or reviewing 3 or more self-study handouts (*n* = 45; $p < .001$). For those pharmacists who reviewed 0 to 2 self-study handouts, there was no significant change in comfort rating after training for any of the 8 comfort

Figure 2. Primary outcome: Change in self-assigned comfort scores pre and post training. **Figure 3.** Secondary outcome: Pediatric experience pre and post training.

Figure 4. Secondary outcome: General staff pre and post training.

statements ($n = 7$; $p = \text{NS}$ for all statements). Those attending 0 to 2 live sessions ($n = 30$) and 3 or more live sessions ($n = 22$) had a significant improvement in comfort rating after training for statements 1-5 and 8 ($p < .01$ and $p < .05$, respectively). Those pharmacists completing fewer than 6 activities ($n = 24$) and 6 or more activities total ($n = 28$) throughout the training period showed similar changes in comfort ratings after training, with significant improvements in comfort ratings after training for statements 1-5 and 8 ($p < .01$ and $p < .05$, respectively).

The average score on the multiple-choice pediatric knowledge-based assessment, prior to completing the training program, was 61% ($\pm 17\%$). After training, the average score significantly increased to 89% ($\pm 10\%$; $p < .0001$). Evaluation by topic revealed significant improvement in the proportion of questions answered correctly for all 5 topics ($p < .001$) after training. Pharmacists with recent pediatric work experience answered a greater proportion of questions correct on the pretraining assessment than pharmacists without pediatric work experience (72% vs 54%, respectively; $p < .0001$); however, after training, both groups saw a significant improvement in proportion of questions answered correct (87% vs 90%, respectively; $p < .001$ for both).

Correlation analysis did not detect a relationship between the change in self-assigned comfort scores and the number of handouts reviewed, the number of live sessions attended, or the overall score on the knowledge-based assessment after training. There was a significant ($p = .01$) positive correlation detected between the self-assigned posttraining survey comfort question scores for all questions except question 6.

Assessment of program perception revealed that, among participating pharmacists ($N = 52$), 73% liked the training program, 23% neither liked nor disliked the program, and 4% disliked the training program.

DISCUSSION

Recognizing the potential for pharmacists to encounter pediatric medication orders and medication-related questions, our institution identified the need to implement and evaluate a formal pediatric training program. With limited data in the literature on effective methods to enhance pharmacists' comfort or knowledge related to general pediatric pharmacy, our program was designed to educate pharmacists on basic pediatric topics with a focus on issues most relevant to the population seen at our children's hospital, as well as reviewing children's hospital policies and procedures relevant to our pharmacy department and the training program topics. The program structure considered the time limitations and schedules of the staff and was primarily self-study to allow for flexible completion of the training program. Teaching handouts were created to serve as a reference for pharmacists both during and after the training program. Live education sessions were offered as an option to appeal to different learning styles, but they were limited to one day per week during the training period due to time restrictions of the trainers.

Overall, the training program was well received by participating pharmacists. Based on responses to comfort statements, the pharmacists who completed the training program collectively expressed increased comfort with assessing pediatric medication orders with confidence, their understanding of pediatric pharmacy protocols at our institution, and their level of preparedness to address pediatric medication orders and medication-related questions. The pharmacists also expressed improved comfort with their personal knowledge of pediatric pharmacy and less anxiety when addressing pediatric medication orders. The training program did not have an impact on perceived time spent verifying pediatric medication orders or anxiety level when responding to medication-related questions. The training program was most impactful in improving the comfort level of pharmacists without recent pediatric work experience compared to those with recent pediatric work experience. Based on changes in a rating from a median level of disagreement to a median level of agreement, the impact of the training program may

have been most significant for improving the comfort level of inexperienced pharmacists. This may be especially true for assessing medication orders, improving their understanding of pediatric protocols and policies, and improving their personal satisfaction with the amount of pediatric training received. The training program was introductory in nature, so the observed lack of impact on comfort for pharmacists with previous pediatric work experience may be explained by these pharmacists possessing a higher baseline level of familiarity with the concepts presented in the training. Overall, reviewing at least 3 of the training program handouts, attending live training sessions, and/or participation through a combination of self-study and live education resulted in significant improvements in comfort for all participating staff. The participants who failed to self-study at least 3 of the training handouts did not report improved comfort as a result of the training program. This is logical given the less than 50% participation in the program.

Overall knowledge of topics addressed in the training program improved based on a greater proportion of correct answers on the knowledge-based assessment after training compared to before training. The pharmacists with previous pediatric experience scored higher on the knowledge assessment than pharmacists without pediatric experience at baseline; but after training, the proportion of correct answers was similar between the 2 groups. This indicates that the training program enhanced knowledge and understanding of presented topics, regardless of background.

There were several potential limitations to our study. Due to the lack of a recognized precedent for staff development related to pediatrics, the comfort statements and knowledge questions utilized were derived specifically for our institutional training program. These questions were not validated prior to study implementation; however, correlation analyses indicate that pharmacists rated all comfort statements except statement 6 in a similar and predictable manner after training. The results of the study are largely subjective, and the survey nature presents potential for various biases by participants, including timing, expectation, selection, and recall bias. Another potential limitation of our training program was that live education was restricted to one day per week in the training period. Unfortunately, not all pharmacists were able to attend the offered sessions, and this was an expressed source of dissatisfaction with the program, even though live education session attendance did not appear to improve comfort ratings or knowledge scores.

Overall, the implementation of a pediatric training program at our institution resulted in significant improvements in most self-reported comfort scores by participating pharmacists. The training program did not impact perceived length of time for verifying pediatric orders or level of anxiety when addressing medication-related questions, but increased pharmacists' confidence with assessing pediatric medication orders, comfort with personal level of pediatric training, and understanding of hospital-specific policies and procedures. Pharmacists reported improved comfort with their personal knowledge of pediatric pharmacy, and this was reflected in improved knowledge after training, regardless of pediatric experience. Overall, self-study training for pharmacists including opportunities for live education may result in improved self-perceived comfort with pediatric pharmacy concepts and basic pediatric knowledge, particularly for those without recent or prior pediatric experience.

At our institution, all newly hired pharmacists receive pediatric training in the pediatric satellite pharmacy. If the pharmacist is to work primarily in one of the pediatric areas, they receive special training. This training includes concepts of the program described above. At least one pharmacist who has received this special training is present in the institution 24 hours per day. While currently there is no annual proficiency testing in place, this program could easily be adapted to assume such a role at our institution and others.

As indicated previously, ACPE guidelines emphasize that school and colleges of pharmacy must prepare their graduates to provide direct patient care in a wide variety of health care settings, for a wide variety of patients.¹⁻³ The foundation for these entry-level skills, with a special population like pediatrics, could be laid both with additional emphasis in the didactic setting and enhanced opportunities in Advanced Pharmacy Practice Experiences.

CONCLUSION

A self-study pediatric pharmacy training program with optional live education sessions resulted in significant improvement in most self-reported comfort scores for pharmacists, particularly those without recent pediatric pharmacy experience. Pharmacists, regardless of experience, demonstrated improved basic pediatric knowledge assessment scores after training.

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