

## Current Topics in Pediatric Pharmacotherapy - PHRD 528

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#### About the instructors

Mary Worthington, Pharm.D. an Assistant Professor of Pharmacy Practice at the McWhorter School of Pharmacy at Samford University in Birmingham, Alabama, holds a joint appointment with the Children's Health System in Birmingham as a Pediatric Clinical Pharmacy Specialist.

Dr. Worthington received her Bachelor of Science in Pharmacy and Doctor of Pharmacy degrees from Ohio State University. For her post-graduate education, she completed a General Pharmacy Residency at the Children's Hospital in Columbus, Ohio and a Residency in Pediatric Pharmacotherapy and Home Health Care at the University of Tennessee in Memphis. She joined Samford University as an assistant professor in the summer of 1995.

Dr. Worthington has been involved with Problem-Based Learning (PBL) since 1999. She has facilitated several student groups in a large therapeutics course that utilizes progressive disclosure cases and additional problem oriented integrated coursework. She and a colleague recently revised an elective course focused on pediatric aspects of pharmacy practice to a primarily problem-based learning format. She also presented a workshop session on problem-based learning and pediatric pharmacy education at the Tenth Annual Pediatric Pharmacy Advocacy Group Conference.

Professional areas of interest for Dr. Worthington include drug therapy related to pediatric infectious diseases and cardiology, and identifying educational needs of pharmacists to best serve the pediatric population. At Children's Hospital, she is a member of the Pharmacy and Therapeutics Committee and Antibiotic Committee, and she is involved in multi-disciplinary health professional education. Dr. Worthington received the Sergio Stagno, M.D. Friend of the House Staff Award and a Teaching Award from the Doctor of Pharmacy Class in 1999.

Kim W. Benner, Pharm.D. an Assistant Professor of Pharmacy Practice at the McWhorter School of Pharmacy at Samford University in Birmingham, Alabama, holds a joint appointment at the Children's Health System in Birmingham, Alabama as a pediatric clinical pharmacy specialist.

Dr. Benner received a Bachelor of Science in Biology/Chemistry from the University of Alabama at Birmingham and then went on to receive her Bachelor of Science and Doctor of Pharmacy degrees from Samford University. She then completed a General Pharmacy Practice Residency at the Children's Health System in Birmingham, Alabama. She joined Samford University as an assistant professor in the summer of 1997.

Dr. Benner has been involved in PBL since 2000. She has facilitated multiple PBL groups in the third year curriculum and recently, along with a colleague, converted a third year Pediatrics Elective course into one that is primarily PBL based. In addition, she contributed towards a PBL monograph entitled "Implementing Problem-based Learning in Pharmacy" that is published in the Samford University PBL monograph in 2002.

Clinical areas of interest for Dr. Benner include pediatric critical care, cystic fibrosis, pediatric pharmacokinetics and drug removal by dialysis. At Children's Hospital, she is an active participant on the Pharmacy and Therapeutics Committee and Pain Committee, and participates in the education of physicians, nurses and fellow pharmacists. Dr. Benner received the Sergio Stagno, M.D. Friend of the House Staff Award in May 2002 from the pediatric residents at Children's Hospital.

### **Introduction**

The practice of pharmacy as related to pediatric patients provides the opportunity for unique challenges and rewards. The purpose of this course portfolio is to examine our efforts in redesigning an elective course devoted to this aspect of pharmacy to utilize problem-based learning (PBL) as the primary pedagogical method. Our goals in converting the course format to PBL include better preparation of our students to be problem-solvers for pediatric pharmacy issues and greater student understanding of the distinctive qualities of pharmacy service to this special population. We will describe how we have attempted to use course design to achieve these goals, and share our observations on the facets of the revised course that we feel were either successful or still require further improvements.

The material in this course portfolio represents work done at Samford University in Birmingham, Alabama. Samford is a privately supported Christian university with a current enrollment of over 4300 students. The Carnegie Classification for Samford University is Masters Colleges and Universities I.

The course represented in this portfolio is part of the curriculum of the McWhorter School of Pharmacy, offered through the Department of Pharmacy Practice. As the two current instructors of this course, we both serve at the rank of Assistant Professor and have completed our Doctor of Pharmacy degrees. Dr. Mary Worthington has been teaching at the college level for over six years and has received an award for "Excellence in Teaching" by the school's 1999 graduating class. Dr. Kim Benner has been teaching at the college level for over four years.

The title of the course represented is Current Topics in Pediatric Pharmaco-therapy, which is listed in the course catalog as PHRD 528 and is offered for two semester credit hours. The course meets for one session of two hours length each week throughout the semester. The catalog description is as follows: "This elective course provides a basic overview of pediatric pharmacotherapy. The course will focus on treatment and therapeutic monitoring of the more common pediatric diseases."

The course is typically taught in the fall semester of the academic year and has an average annual enrollment of twenty students. The course is offered as an elective course for students in the third year of a four year professional program which leads to the conferment of the Doctor of Pharmacy degree. The course has been offered by the School of Pharmacy for a number of years, but the redesign to utilize PBL as the primary pedagogical method has occurred over the past two semesters it has been taught (Fall of 2000 and 2001). Prior to 2000, the class format consisted primarily of lectures from faculty and guest speakers, in addition to one group project that involved a presentation on a controversial pediatric therapeutic issue. After revision, the pediatric pharmacy elective now utilizes approximately 70% PBL as the instructional method, with the remainder of time devoted to faculty or guest speaker lectures and evaluation purposes. The decision to limit PBL to a portion of the course was based on its elective status in a semester where students are engaged in multiple required courses that also utilize PBL or other time-intensive active learning methodologies.

## **Course Design**

### **A. Rationale**

The impetus to redesign the pediatric pharmacy elective course had two main origins. First, in the summer of 2000, we performed an assessment of the total content in the school's Doctor of Pharmacy curriculum that was dedicated to pediatric pharmacy topics. The information from this review prompted us to reconsider the specific course material that was provided in the elective. Secondly, we were inspired by the experiences and momentum provided by Samford University in exploring PBL methodology; and we believed the elective students could benefit from a change in instructional approach. From this basis, we identified five goals for improvement in the course: 1) incorporation of patient cases to provide students experience in identifying and solving pharmacy-related problems in infants and children; 2) increased student exposure to pediatric drug information resources; 3) more opportunities for communicating information specific to pediatrics; 4) increased student motivation for learning; and 5) inclusion of some new subject material with better organization to increase student appreciation of the changing nature of the pediatric patient, particularly as related to drug issues.

Our thesis was to explore if PBL in a progressive-disclosure case format would work as teaching methodology to help us accomplish these objectives. Since its conception in medical education over thirty years ago, PBL has been widely used to motivate learning in students of this discipline, with one of its primary objectives being to build skills in clinical reasoning. These skills include hypothesis formation, attainment and analysis of information, problem synthesis, and decision-making abilities.<sup>1</sup> We believed the same aptitudes were necessary for our students to be able to identify and solve problems in relation to pediatric pharmacy issues.

Several courses in the Doctor of Pharmacy curriculum at the McWhorter School of Pharmacy had already been changed to a full or partial PBL format, and we were able to draw on the reported experiences from these classes in how PBL impacted pharmacy student motivation and proficiencies in problem-solving and communication. Revised pharmacy courses included classes in the pharmaceutical sciences, clinical practice and administration. Sims reported on the revision of two courses, pharmacokinetics and pharmaceuticals, to incorporate PBL and other active learning methods. In both of these classes, peer-group teaching methods in case study formats were used to build student confidence and skills in "learning, interpreting, analyzing, researching and solving problems."<sup>2,3</sup> Monk-Tutor described the redesign of a large, lecture-based human resources management course to utilize progressive-disclosure cases, group work, and a reflective student portfolio. Course assessments indicated that students improved their skills in problem-solving, teamwork, and communication in addition to content knowledge.<sup>4</sup> Finally, Beckett and colleagues reported on the implementation of PBL at a more curricular level by detailing its incorporation into four core courses. These authors noted PBL helped to engage and motivate students.<sup>5</sup> Based on these positive results of PBL that directly related to our goals for change in the elective, we initiated the conversion to this pedagogical approach.

### **B. Reflection on Course Content**

In the redesign process, we first focused on evaluating the course content. We reflected on aspects of pharmacy practice that we felt were particularly challenging or specific to the pediatric population. Many disease states are exclusive to, or have a higher incidence in, infants and children. Managing drug therapy for these and other diseases in this patient population is complicated by a diversity of factors. First, many medications do not receive approval from the Food and Drug Administration for use in the pediatric age group, although they are often necessary for treatment. Therefore, it is important for a pharmacist to be able to utilize drug information resources appropriately to obtain available data on a drug's pediatric use. Second, nearly all medication dosing for infants and children is based on their weight or body surface area, and requires individualized calculations. These computations can be a risk for medication

errors. In addition, many drugs are not manufactured in dosage forms appropriate for pediatric patients, and extemporaneous compounds must be prepared to allow for a drug's usage. Compounding of medications is another potential source of error. Finally, growth and development influence medication usage through alterations in a given medication's pharmacokinetics, the ability to utilize different drug formulations, and the psychosocial aspects of responsibility for one's health and compliance. Because all these issues are critical to pediatric pharmacy, we felt they were important to address in course content. We, therefore, made a conscious effort to incorporate these areas as we developed patient cases.

Our initial decisions related to change of course content were also influenced by comparing the McWhorter School of Pharmacy's total pediatric pharmacy education to that provided by other Doctor of Pharmacy programs. In 1999, Low and colleagues published the results of a survey that evaluated didactic and experiential curricular content dedicated to pediatrics in United States schools of pharmacy. Based on responses from thirty-seven colleges, the mean time devoted to pediatric subject matter in required coursework was  $16.7 \pm 11.6$  hours. Common topics included in > 80% of programs were treatment of otitis media and meningitis, immunizations, pharmacokinetics in children, and pharmacotherapy of cystic fibrosis. The offering of additional pediatric elective courses was also noted at 54% of the surveyed schools.<sup>6</sup> At the time of our assessment, the McWhorter School of Pharmacy curriculum contained 16 hours of required pediatric subject material including the most common topics taught at other universities (Table 1). Because all of the elective students are instructed on these mandatory topics, we wanted the course content to build upon or be supplementary to this base knowledge.

Table 1: McWhorter School of Pharmacy required pediatric coursework

<b>Pediatric Topic</b>	<b>Hours devoted to topic</b>
Meningitis	2
Otitis media/sinusitis/pharyngitis	3
Pharmacokinetics	2
Fluid and electrolytes	1
Congenital heart disease	1
Human immunodeficiency virus	2
Cystic fibrosis	2
Pediatric epilepsy	2
Childhood immunization	1

Subject material in previous versions of the course included material on drug management of neonatal patients, pediatric drug dosage, and poison prevention. We felt it was important to continue to cover these knowledge areas in the elective. In the survey administered by Low and colleagues, these topics were often found in pharmacy required or elective studies.<sup>6</sup> From their survey, we were also able to identify the management of pediatric asthma, fever and attention deficit disorder as additional content areas related to disease states that were ideal for inclusion in the course. A complete list of the elective's learning objectives can be found in the "course syllabus" section of the course webpage available at <http://www.samford.edu/schools/pharmacy/528.htm>.

### **C. Reflection on Instructional Practice**

Our greatest initial challenge in incorporating PBL into the elective course; was developing patient cases that were motivating and appropriately reflected our desired content. In a contemporary PBL review for dentistry, Barrows emphasizes that one of the primary objectives of authentic PBL is the development of student curiosity and motivation for learning. He notes that students must perceive material as relevant and essential to their future professional work. He stresses that the problems utilized should be real patient issues that either occur frequently or if

rarely, their management has significant impact on patient well-being and/or health care cost.<sup>7</sup> We believed these concepts were directly applicable to designing patient cases for our course, and we used them as guiding principles during development.

To maximize the revisions we were making in incorporating PBL, we organized the subject material by dividing the course into three periods, each lasting four weeks: 1) neonatal; 2) infancy and early childhood; and 3) older childhood and adolescence. Each period was structured to begin with two weeks of case-oriented learning, followed by a week of lecture/discussion to reinforce case material, and concluding with a week of student presentations related to the subject matter in the periods. For the case-oriented learning, students were randomized into groups. Half of these student groups were assigned to a case involving a male neonatal patient and the remainder to one involving a female neonate. Each group maintained the same patient in all three periods of the course, simulating the "growing-up" of the child. This longitudinal use of the same patient was employed as a technique to emphasize the changing nature of pediatric patients and continuity of health care provision. Many parallel disease states, treatments and other pharmacy issues were woven into the content of both cases (Table 2). However, different therapies and disease states were also addressed in the two patient cases and therefore, by the two sets of student groups. This differing material served as the subject matter for student presentations. Although neither patient was an actual case, we relied heavily on our real life experiences as clinical practitioners for pediatric patients and utilized aspects of real patient situations during case development. Full versions of both cases are available under the "case study examples" section of the course Webpage (<http://www.samford.edu/schools/pharmacy/528.htm>).

Table 2: Course content as developed in longitudinal patient cases

Course Period	Male Patient	Female Patient
Neonatal	Prematurity Respiratory Distress Syndrome Bronchiolitis	Prematurity Respiratory Distress Syndrome Apnea
Infancy- Early Childhood	Fever Cough/Cold Immunizations Medication Errors Pediatric Asthma	Fever Cough/Cold Immunizations Medication Errors Bronchopulmonary Dysplasia
Older Childhood- Adolescence	Attention Deficit Disorder Herbal therapies	Acetaminophen Toxicity Herbal therapies
Content addressed in all three periods	Growth and development Dosing calculation Counseling Pharmacokinetics	Growth and development Dosing calculation Counseling Pharmacokinetics

### PBL Context and Application

Case development was a rigorous process as it consumed much of the time resource we had available for the course in the first year of the revision. We had initially planned on presenting the case-based material in a progressive-disclosure format with the students developing their own learning issues in response to the material. In a review of teaching methodologies in pharmacy education, Brandt notes the importance of the student centered approach in classical PBL. She describes this aspect of the PBL method as the learner determining what they need to know.<sup>8</sup> Because of the time challenges in preparing course materials and concern for student workload, we resigned ourselves to a more student centered method occurring in a two step process. Therefore, in the first year of revision, we progressively disclosed case information but provided the students learning objectives with each phase of new material. Although this was

not authentic PBL, we found our students did actively engage in both provided and self-derived learning objectives. In the second year of course offering, we removed the learning issues that were provided at the end of each phase of the patient cases. This change did result in students broadening their review of the presented case instead of primarily answering the provided questions.

However, it is our reflection that students still need to increase the depth to which they examine, assess, and solve problems within the patient cases. It is important to orient the students to a problem-solving approach, and we may have inadequately prepared our students for problem evaluation. We provided minimal orientation to a PBL process due to the exposure our students had already obtained with this methodology in the previous two years of the pharmacy curriculum. In the next course offering, we plan to include an introduction to the patient cases which will outline a basic approach the students can expand upon as they address the material in the cases. We are considering utilizing the expanded S.O.A.P. format as described by Wallace and Franson. This systematic method is comprised of six steps: 1) identification of subjective and objective data; 2) assessment of existing therapy; 3) assessment of treatment options; 4) provision of specific therapeutic recommendations; 5) identification of treatment goals, endpoints and monitoring parameters; and 6) provision of education to patients or other health care providers.<sup>9</sup>

To further address the need for increased depth, we plan with the next course offering to provide a facilitator for each student group in the class. Currently, students work in groups of four to five members, and we both facilitate for two or three groups. Barrows notes that the facilitator provides the backbone for successful PBL.<sup>7</sup> We have found it very challenging to be this support for multiple groups, even if we can interact with each group several times in a class session. Therefore, we are recruiting two post-graduate pharmacy residents specializing in pediatrics to serve as facilitators in the course for next year. To allow for a facilitator to work with each group, we may have to minimally increase the number of students per group. An extra benefit of utilizing the pharmacy residents is the opportunity to increase their teaching experiences as they may choose to pursue an academic career after completion of their post-graduate training.

Even though we believe our students can increase their level of depth related to the patient cases, one aspect of course revision we found successful was student motivation. Students seemed genuinely interested in how the cases evolved, particularly as related to the different developmental periods. They also often exceeded our expectations when presenting case material. Finally, most student groups had a good level of camaraderie, sometimes based on whether they were working with the boy or girl patient. To keep up with the considerable amount of paper generated by utilizing PBL cases, we coded male patient materials on blue paper and female patient materials on pink paper which seemed to contribute slightly to the team spirit atmosphere.

Another successful aspect of the PBL revision is the perceived relevance of the patient case materials to actual practice. After completion of the elective, one of the students commented to us how helpful these materials were to her as she followed actual patients on a fourth year pediatric pharmacy clerkship. In the second offering of the revised course, an additional change was made in response to prior year evaluations of the course that noted more relevance to community pharmacy practice was needed. This modification was the assignment of practical pediatric problems that could be commonly encountered in a community pharmacy setting, such as the treatment of diaper rash or choice of car seats or infant formulas. These problems were posed as questions from a parent to the pharmacist and are provided on our webpage under "case study examples" (<http://www.samford.edu/schools/pharmacy/528.htm>). One problem was assigned to each student group, and the students were instructed to prepare and present

potential solutions to their assigned question. Minimal guidelines were given on how to approach the problems, but we did specify the importance of including cost factors. Moon and Gitterman described a similar education experience for pediatric medical residents where they were required to complete a shopping exercise. The majority (92%) of participants in their program found it a worthwhile experience.<sup>10</sup> Our students also seemed to benefit from their similar projects, and we plan to continue to use these problems in the course.

### **Student Understanding - Evidence of Students Meeting the Learning Objectives**

Student presentations are a valuable evaluation tool that we utilize in assessing if students have achieved the learning objectives of the course. Students in the elective are expected to be able to recognize and solve medication problems in the pediatric population and to communicate information related to pediatric patients and pharmacy issues. A major assessment of the achievement of these abilities is the group presentations of the patient cases in one particular period of child development. In preparation for this project, students are provided with a guide for the development of the case presentations and the evaluation form that is utilized to assess their performance. These materials are available for review in the "course syllabus" section of the elective webpage (<http://www.samford.edu/schools/pharmacy/528.htm>). In addition, early in the course sequence, a post-graduate pharmacy resident presents a different patient case to the students as a guide for model performance. An example of a student-produced case presentation is available for review on the course webpage under the heading "student project examples". This project on pediatric asthma management as related to the male patient in the infancy/early childhood period typifies student work. We initially had concerns that the students would simply reiterate facts that were provided to them; but, as shown in this example, we found students provided appropriate additional material and assessment of the patient's therapeutic management. Successful completion of this project also helps to fulfill the learning objective of identifying and utilizing appropriate information resources. A weakness of the available example is that the students did not list the references which were utilized for the project. In review, this deficit occurred in many of the presentations, and greater emphasis needs to be placed on the importance of documentation related to information sources.

In the second year of course revision, we were also able to evaluate student communication abilities through the group presentations of the solution to a practical pediatric problem. Creativity was encouraged for this group work, and students were again given a copy of the evaluation tool for the presentation. This form can be found in the "course syllabus" section of the webpage. The handout from a presentation provided by one of the student groups that reviewed the common problem of "diapers and diaper rash" is also available for review on the webpage under "student project examples". Again, this example was typical of student work. Group presentations for this project exceeded our expectations as some groups employed unique learning techniques such as role-playing and visual aids of the actual product being reviewed (e.g. bringing in a car seat to review proper placement). Following both types of student presentations, ample time was allowed for faculty and students to interact to ensure adequate learning of the group project materials.

Although they were not utilized for formal student evaluation, we obtained additional evidence of students achieving desired course outcomes through pre- and post- course surveys. The initial survey was distributed to the students on the first day of class to assess what knowledge and abilities the students perceived they had already obtained related to pediatric pharmacy. The survey was then redistributed on the last day of class or after the final exam, to assess the impact the students believed the course had on the same knowledge and abilities. The survey was distributed the last two years the course was taught (Fall of 2000 and Fall of 2001). The questions asked on the survey and the results are presented in Table 3. We had 100% response rate at all sampling times; the decrease in number of responses from pre- to post-survey in 2001 was due to student attrition. The scale of reference used on the survey was based on a scale

from 1-5, with one representing minimal knowledge/ability and five representing highly able/effective. In general, the results demonstrate an increase in student perception of their knowledge and skills related to pediatric pharmacy from pre- to post-survey in both years. An item of particular note is the increase in the students' estimation of their ability to calculate pediatric drug dosages, an important skill for a pharmacist to help reduce the rate of medication errors. The perceived improvement by the students reaffirms our belief that major course goals were met, in this case, being able to calculate pediatric doses. Other skills in which the student's noted self-improvement included the ability to present a patient case and communicate drug information. Since these skills are fostered by PBL, we believe the apparent strengthening of these abilities may be related to the use of this methodology in the course. The survey also included one open-ended question which asked the students to list unique aspects of pediatric pharmacy. In the fall of 2001, the answers showed no improvement in the students' identification of quantity of pharmacy issues distinct to the pediatric population, as compared to the positive trend on the prior year survey. We feel this difference could be due to weariness on the students' part as the time taken for this post-survey seemed shorter than in previous times. Unlike the prior year, it was distributed after the final exam that occurred at the completion of finals week. Perhaps in the future to gain more insightful answers, we should distribute the survey on the last day of the class to eliminate the students rushing through their answers.

Table 3: Pre-course and post-course assessment with mean response rate

	<b>Fall 2000</b>	<b>Fall 2000</b>	<b>Fall 2001</b>	<b>Fall 2001</b>
<b>Question</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=20)</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=18)</b>
Rate your current knowledge of drug therapy as applied to pediatric patients.	2.05	3.8	1.5	3.67
Rate to what extent this course increased your knowledge of drug therapy as applied to pediatric patients.	-	4.4	-	4.22
	<b>Fall 2000</b>	<b>Fall 2000</b>	<b>Fall 2001</b>	<b>Fall 2001</b>
<b>Question</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=20)</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=18)</b>
Rate your current ability to read information on pediatric pharmacy topics and then apply this information.	3.11	4.45	2.85	4.5
Rate to what extent this course increased your ability to read information on pediatric pharmacy topics and then to apply this information.	-	4.45	-	4.33
Rate your current ability to calculate pediatric drug dosages.	2.68	4.8	1.8	4.56
Rate to what extent this course increased your ability to calculate pediatric drug dosages.	-	4.2	-	4.39
Rate your current ability to counsel pediatric patients or their caregivers on drug therapies.	2.5	3.85	1.95	3.83
Rate to what extent this course increased your ability to counsel pediatric patients or their caregivers on drug therapies.	-	4	-	3.89
Rate your current ability to present a patient case with focus on drug therapy.	2.74	4.25	2.4	3.83
Rate to what extent this course increased your ability to present a patient case with	-	4.25	-	4.33

focus on drug therapy.				
Rate your current ability to communicate drug information in a formal presentation.	3.21	4.2	2.75	3.83
Rate to what extent this course increased your ability to communicate drug information in a formal presentation.	-	4.1	-	3.78
How effective are patient cases in helping you to acquire knowledge of pharmacotherapy?	3.79	4.35	3.5	3.85
How effective are patient cases in helping you to learn to apply pharmacotherapy?	4.05	4.45	3.7	4.0
How effective are lectures in helping you to acquire knowledge of pharmacotherapy?	4.32	3.7	3.7	4.1
How effective are lectures in helping you to learn to apply pharmacotherapy?	3.53	3.95	3.3	3.61
	<b>Fall 2000</b>	<b>Fall 2000</b>	<b>Fall 2001</b>	<b>Fall 2001</b>
<b>Question</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=20)</b>	<b>Pre-course (n=20)</b>	<b>Post-course (n=18)</b>
What pharmacy issues are unique to the pharmacy patient population? (number of responses per student)	0 responses:5 1 response: 3 2 responses: 9 3 responses: 3	0 responses: 4 1 response:3 2 responses: 8 3 responses: 4 4 responses: 1	0 responses: 4 1 response: 7 2 responses:5 3 responses:3 8 responses:1	0 responses:5 1 response:3 2 responses:4 3 responses:1 6 responses:2

### Student Understanding - Reflection on Evidence of Student Learning

Student assessment is an area of our PBL revision process that we believe still has a considerable opportunity for improvement. Outside of the group presentations, we have continued to utilize traditional testing methods to evaluate the students' knowledge and abilities. In the previous two years of the revision process, a significant portion (40%) of the students' grades has been based on a final exam that is primarily in a multiple choice format. This form of evaluation primarily assesses the students' abilities to recognize content instead of the desired course outcomes, e.g. the ability to solve pediatric pharmacy problems. For the next course offering, we plan to alter the assessment process by replacing the final exam with evaluations of individual student portfolios. Our ideas for portfolio content include: 1) self assessments of problem-solving skills in each period of the patient cases; 2) a written evaluation of drug therapy in one period of the case with appropriate primary literature citation; 3) self assessments of contribution to group projects; and 4) a brief essay on the student's perception of the role of the pharmacist in caring for pediatric patients. We hope a change to this evaluation format will allow us to better examine if students are achieving the learning objectives.

Additionally, since PBL methodologies are structured to stimulate teamwork and foster analytical skills that simulate real-life pharmacy practice, we are curious if exposure to our elective coursework improves student performance on pediatric clerkships. Nii and Chin evaluated how PBL versus didactic learning affected student performance on required and elective pharmacy clerkships. They compared student grade point averages (GPA) on rotations for two study groups, PBL versus didactic lecture. They found that student GPA's for the PBL group were significantly higher than those of students in the didactic group.<sup>11</sup> Similarly, we are interested in comparing how students perform on a pediatric clerkship based on whether on not they took the elective course. This comparison could provide useful information on the impact of the elective class, but it would be difficult to ascertain what, if any, differences were related to PBL. In addition, the current clerkship evaluations are subjective and multiple preceptors evaluate students on pediatric clerkships. These limitations could create inconsistent results.

However, we still believe this form of assessment could provide worthwhile information on how the elective affects student performance in real-life situations.

### **Summary**

Several goals were delineated for improvement of a pediatric pharmacy elective course including: 1) greater student exposure to identifying and solving pharmacy problems in infants and children; 2) increased student understanding of distinctive aspects of pediatric pharmacy practice; and 3) more student experience in communicating information in relation to pediatric patients and pharmacy issues. It is our opinion that we have largely met these goals after course redesign to a partial PBL format. The incorporation of progressive-disclosure patient cases provided the students the opportunity to solve pediatric pharmacy problems. By using this type of PBL, students also learned to utilize appropriate pediatric information resources which was another specific learning objective of the course related to problem-solving. A unique facet of the course was the longitudinal nature of the progressive-disclosure cases. Two patient simulations were developed for use throughout the entire course; and these cases, one a boy and one a girl, focused on real life problems as the patients aged. The students were able to watch a patient grow and experience disease states specific to different phases of child development. Careful attention was given during the case design process to incorporate aspects of pharmacy practice that were particularly challenging or distinct to the pediatric population. In addition, case content was critically evaluated in the context of the required pediatric coursework in the pharmacy curriculum. Working in groups to solve pediatric pharmacy problems provided the students with opportunities to build collaboration and communication skills. Students were assessed on their abilities to communicate pharmacy information through group presentations related to the pediatric patient cases and an additional scenario involving an infant or child in the community pharmacy setting. Evaluation of the student presentations was a valuable tool for assessing if students had achieved desired outcomes for the course. Students were generally thorough and often creative in peer-teaching their classmates on pediatric pharmacy issues. Positive evidence of students accomplishing the learning objectives of the course was also reflected in pre- and post-course surveys and in comments when interacting with elective students in the next year on pediatric pharmacy clerkships.

Continual assessment and improvement of a course are necessary to ensure that we provide the best education we can to our students. We try to keep this course dynamic, attempting to learn from prior semesters and being open to changes that will improve our course. We first initiated change with the adoption of a PBL format. It is our current reflection that students could further benefit from the progressive-disclosure patient cases if they approached them with a more in-depth level of inquiry. Through our experiences, we have learned the importance of students understanding the PBL process. In the next course offering, we believe we can guide the students to pursue the patient cases to a greater extent through a better orientation to a PBL approach specific for the course. We also plan to increase the number of facilitators to improve the faculty to student group ratio. We have also learned the importance of evaluating the students by a method that corresponds with the desired student outcomes. An additional revision we plan for the elective is to change how we assess the students. We intend to replace a final exam that primarily uses multiple choice questions with an evaluation of individual student portfolios. We believe this form of assessment will allow us to better evaluate the active learning goals of the course. In conclusion, the use of PBL methodology to revise a pediatric pharmacy elective course resulted in achievement of goals for improvement identified for the course and continues to inspire changes that will further improve the course and benefit students.

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