

Pediatric Pharmacy Education for U.S. Entry-Level Doctor of Pharmacy Programs

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We surveyed U.S. pharmacy colleges requesting information about pediatric didactic content, reading assignments, clerkships, and amount of time dedicated to these experiences in entry-level PharmD programs. Six of 61 responding colleges were excluded from data analysis because they did not offer this degree. An average of 16.7 hours was devoted to pediatric content in required courses. This content varied extensively; only seven topics (otitis media, immunizations, meningitis, cystic fibrosis, pharmacokinetics, asthma, and fluid and electrolyte therapy) were included by greater than 70 percent of programs. Fifty of the 54 reporting programs (93 percent) offered at least an elective pediatric clerkship and all planned to. Eleven programs (20 percent) required pediatric clerkships. Forty-one percent of students enrolled in these 50 colleges would complete a pediatric clerkship. Pharmacy colleges should assure that their didactic and experiential curricula adequately prepare their graduates to provide appropriate pharmaceutical care to the neonatal-through-adolescent population.

INTRODUCTION

The topic of medication use among pediatric patients has recently received national attention, with new federal initiatives for studying medications commonly used in pediatrics and increased pressure on the pharmaceutical industry to conduct pediatric research prior to FDA approval(1). Pharmacists frequently are involved in the pharmaceutical care of pediatric clients, yet little is known about the pediatric didactic or experiential content of doctor of pharmacy degree programs. Mangione reported a limited survey of pediatric pharmacy education in 1990, but did not examine topics or time dedicated to such education(2). Bahal-O'Mara and Nahata reported a survey of the status of didactic and experiential pediatric pharmacotherapy education in entry-level pharmacy programs (54 BS, 11 PharmD) in the United States and Canada that they completed in 1991(3). As colleges develop doctor of pharmacy curricula and address curricular reform, we felt it would be useful to characterize the pediatric didactic and experiential contents of existing PharmD programs to serve as a guide for curricular development or revision.

METHODS

Questionnaires about pediatric pharmacy education were being developed simultaneously by faculty from the University of Nebraska Medical Center (UNMC) and the Pediatric Pharmacy Advocacy Group, Inc. (PPAG) Advocacy Committee. While arranging for pilot testing of the UNMC survey, this duplication of effort was detected. UNMC investigators contacted the PPAG investigator and an agreement was reached to conduct a cooperative survey. It was decided to combine questions from the two instruments. Major pediatric topics were identified by a review of pediatric medicine and pediatric pharmacy references to develop a three-page questionnaire that requested information about specific pediatric didactic content, reading

assignments, and clerkship experiences in PharmD curricula. This instrument was pilot tested by two pediatric faculty members in different colleges then revised for clarity. The survey (Appendix) and postage paid return envelope were mailed to the deans at each of the 79 colleges in the United States and Puerto Rico in March 1997. The request was made of the dean to forward the survey to the faculty member best qualified to complete it (*e.g.*, pediatric faculty member or curriculum committee chairperson). After four weeks, a follow-up reminder letter and a duplicate copy of the survey was mailed to non-respondents.

Those colleges having an entry-level PharmD program were requested in the first two survey questions to complete the entire survey. Those that did not have such a program or did not plan to implement one within the next two years were asked not to complete the survey beyond the first two questions. Respondents were asked to estimate time spent dedicated to pediatric disease states in didactic courses, discussions, or case studies that are included in the required and the elective didactic curriculum. Specific pediatric disease states and topics were listed on the form with additional spaces for faculty to add topics. The survey asked for estimates of time spent by students completing required pediatric topic readings. The clerkship section ascertained whether pediatrics was a required rotation, and, if not, how many students take pediatrics as an elective rotation on an annual basis. Respondents described any specialized pediatric clerkship areas and the number of students involved with those sites each year. All three sections solicited written comments.

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Table I. Pediatric topics in required curriculum (N = 37)

Pediatric topic	Minutes devoted to topic		Percentage of programs including topic
	Mean \pm SD	Range	
Otitis media	62 \pm 38	15-150	89
Infectious Disease (meningitis)	72 \pm 57	15-240	86
Immunizations	64 \pm 32	15-120	86
Pharmacokinetics in Children	83 \pm 49	30-240	84
Cystic Fibrosis	73 \pm 41	5-120	81
Asthma / Respiratory Disorders	122 \pm 163	10-720	78
Fluid & Electrolyte Therapy	55 \pm 34	5-120	70
Drug Dosage and Administration	77 \pm 98	15-520	68
Fever	37 \pm 25	5-120	58
Nutrition	96 \pm 49	30-180	54
Infectious Disease (UTI's, other)	68 \pm 51	5-180	51
Diarrhea	36 \pm 27	5-120	51
Seizure Disorders	106 \pm 141	15-600	46
Management of Poisoning	100 \pm 80	20-300	41
Neonatology	92 \pm 102	15-450	41
Oncology	86 \pm 51	10-240	41
Diabetes	59 \pm 52	5-180	41
Infectious Disease (Sepsis)	40 \pm 27	10-120	41
Infectious Disease (Pneumonia)	31 \pm 15	10-60	38
Behavioral Disorders	83 \pm 86	15-360	35
Cardiology	55 \pm 37	5-120	35
Growth and Development	47 \pm 37	5-120	35
Hematology	53 \pm 38	10-120	27
Dermatology	53 \pm 47	10-180	27
Drug Information	38 \pm 24	10-90	27
Other ^a	84 \pm 51	20-180	24
Gastrointestinal Disorders	48 \pm 36	5-120	24
Cardiopulmonary Resuscitation	50 \pm 34	5-120	24
Endocrine/ Metabolic Disorders	36 \pm 33	15-120	22
Parasitic Diseases	34 \pm 33	5-120	22
Pain Management	34 \pm 18	10-60	19
Renal Diseases	28 \pm 16	10-60	16
Transplant	18 \pm 8	10-30	8
Child Abuse	18 \pm 13	5-30	5
MEAN TOTAL	1003	170-3165	

^aMiscellaneous write-in topics

Survey responses were compiled on a Microsoft Excel spreadsheet. All data analysis, mean, median, ranges, and standard deviation were performed using standard Excel formula functions.

RESULTS

Responses were received from 61 of the 79 colleges of pharmacy (77 percent response rate). Of the 61 colleges, six currently had no entry-level PharmD program and reported having no plans to implement one in the next two years. Of the remaining 55 colleges, 44 currently offered an entry-level Doctor of Pharmacy degree; this represents 79 percent of the 56 colleges which were offering the PharmD degree as the first professional degree in 1996-97(4). The other 11 of the 55 colleges planned to implement an entry-level Doctor of Pharmacy degree within the next two years; they were instructed to project anticipated pediatric education within their curriculum. These projections were included in data compilation. One college reported that they had an entry-level PharmD program but did not complete any other survey questions.

The average current or anticipated graduating class size for the

Table II. Topics most often included in elective pediatric didactic studies (N = 17)

Focus area	Percent
Fluid & Electrolyte Therapy	59
Nutrition	53
Asthma / Respiratory Disorders	47
Growth and Development	47
Drug Dosage & Administration	41
Immunizations	41
Neonatology	41
Pain	41
Otitis media	35
Infectious Disease (meningitis)	35
Cystic Fibrosis	35
Seizure Disorders	35
Infectious Disease (UTI's, other)	35
Cardiology	33

54 reporting entry-level PharmD programs was 77 PharmD students, with a range of 6 to 182. Of 53 reporting colleges, 21 (40 percent) had revised their curriculum in the last 5 years, and 32 (60 percent) were currently revising it. Three colleges reported both recent and current revision. Two colleges were planning to revise their curriculum in the next five years.

Required Didactic Content

Of the 55 colleges offering an entry-level PharmD degree, 18 programs did not indicate whether any pediatric topics are covered or they indicated that the program was new and the pediatric topics had not been finalized. One college reported topics covered without times but did not indicate if these were current or planned. Four other programs only indicated that the topic was included in the curriculum and did not indicate the time spent on each topic. These five programs were excluded from the time averages and ranges, but are included in the number of colleges that covered each topic. For the remaining 37 programs, the mean time devoted to pediatric topics in required courses was 16.7 \pm 11.6 hours (range 2.8 to 52.8 hours.) Table I lists the pediatric topics that were included in required courses. Topics which were written in by respondents were transcribed to the appropriate pre-existing category when appropriate; the remainder of written additions are included on Table I as "other."

Elective Didactic Coursework

Ten PharmD programs (18 percent) indicated that they offered a separate elective course in pediatrics; an additional twenty programs (36 percent) offered elective didactic coursework in pediatrics in the curriculum, but not as a freestanding course. The average number of students enrolled in the separate pediatric elective course was 25 (range: 11 to 50) students per year. Elective pediatric didactic topics varied widely, with fluid and electrolyte therapy and nutrition being the only areas covered in more than half of the colleges offering such coursework (Table II). These would need to be considered in the context of the required pediatric didactic topics by individual colleges. Three programs that indicated they offered elective didactic coursework but did not indicate which topics were excluded from Table II.

Required Reading Assignments

The survey requested faculty to estimate the amount of time spent by students completing required reading assignments related to pediatric care to determine their extent of use

Table III. Topics most often included in required pediatric reading assignments (N = 38)

Focus area	Percent
Asthma / Respiratory Disorders	95
Otitis media	92
Infectious Disease (meningitis)	92
Pharmacokinetics in Children	84
Cystic Fibrosis	84
Immunizations	84
Fluid & Electrolyte Therapy	84
Drug Dosage & Administration	76
Seizure Disorders	71
Nutrition	68
Fever	68
Infectious Disease (UTI's, other)	66
Sepsis	63
Pneumonia	63
Diarrhea	63
Neonatology	58
Poisoning	58
Gastrointestinal Disorders	58
Diabetes	55
Growth and Development	53

and to identify topic areas and levels of emphasis. Thirty-eight programs reported information about the required reading assignments in their curriculum. Topics which were cited by more than half of the 38 reporting colleges are included in Table III. A mean estimate of 22.8 hours of reading was reported by these colleges. Many educators expressed doubt in their written comments that the students actually completed the assignments. Some programs performed independent assessment of the topics covered in reading assignments to assure that students completed the readings.

Clerkship Content

Of the 54 responding entry-level PharmD programs, 50 (93 percent) offered a clerkship rotation in pediatrics. The remaining four programs have new PharmD curricula and do not currently have students enrolled in clinical rotations, but plan to offer an elective rotation in pediatrics for these students. A clerkship rotation in pediatrics was required in 11 (20 percent) of the PharmD programs. Two of these programs reported five week clerkships; the remainder were four weeks. The average clerkship was 41.3 hours per week (range 40 to 55 hours). A total of 584 students per year (ranging from 6 to 98 students per program) participated in required pediatric clerkships. Inpatient hospital clerkships with a general pediatrics focus was the predominant rotation site (Table IV). Eighty-three percent of the 47 responding programs offered rotations in more than one area of pediatric practice. Only 40 percent of these programs offered any ambulatory rotations in pediatric practice.

DISCUSSION

Many curricular changes have taken place during the six years since the last survey of undergraduate pediatric pharmacy education (3). Pharmacy education has been transitioning to the entry-level Doctor of Pharmacy degree, and educational reform is underway at many colleges. Given these trends, we limited our study to the determination of the pediatric curricular content in entry-level Doctor of Pharmacy degree programs in the interest of helping to direct curricular reform in the area of pediatric education.

Table IV. Student pediatric clerkship enrollment by focus area (N = 47)

Focus area	Number (percent) reporting	Average annual enrollment
General Pediatrics - Inpatient	45 (96)	18
Neonatal Intensive Care Unit	29 (62)	7
Pediatric Intensive Care Unit	25 (53)	6
Hematology or Oncology	19 (40)	6
General Pediatrics - Ambulatory	16 (34)	10
Other Inpatient Specialty	9(19)	6
Ambulatory Specialty	5(11)	7

Bahal-O'Mara and Nahata recommended that a minimum of 14 to 16 hours of required didactic course work in pediatric pharmacotherapy be included in pharmacy curricula(3). This study found that PharmD programs were devoting an average of 16.7 hours to such required curriculum. However, time so dedicated varied from 2.8 to 52.8 hours. These are, at best, estimates since pediatric content is often interspersed throughout many courses and sometimes as portions of lectures. We suggest that 16 to 17 hours of required didactic coursework or an equivalent exposure through active learning methods be included in entry-level PharmD curricula.

Lesar *et al.* reported that 69.5 percent of prescribing errors involving dosage equations in a teaching hospital over a 13-month period involved orders for pediatric patients(5). Rowe *et al.* found that 55 percent of pediatric residents in a Toronto hospital made one or more errors on at least one of 10 routine dosing calculation questions(6). Two of the ten questions contained dosages that were deliberately excessive; only 12 percent of the residents detected both inappropriate doses. Pharmacists must assure that correct dosages have been ordered, regardless of the population. This survey revealed that only 68 percent of programs reported the topic of pediatric drug dosage and administration in required didactic course content.

Shaffer *et al.* administered a multiple choice questionnaire prior to a pediatric continuing education program and showed that less than half of the pharmacists knew the appropriate management for common pediatric disease states(7). Pharmacists who had received pediatric instruction while in school had a higher correct response rate (52.5 versus 44.6 percent). This underscores the need for pediatric education at the undergraduate level, as well as more continuing education for practicing pharmacists in this area. Although Joint Commission on Accreditation of Healthcare Organizations has mandated age specific competencies for pharmacists that work in health systems, there has been no such mandate for community pharmacists(8).

As health-care shifts from an inpatient to an ambulatory care environment, only 40 percent of the 47 responding entry-level PharmD programs reported the availability of an ambulatory rotation in pediatrics. This will probably represent the major future direction for growth of pediatric clerkships as patient care continues to transition from an inpatient to an ambulatory care environment. It is concerning that less than 40 percent of colleges reported inclusion of required didactic material on pediatric topics such as behavioral disorders, dermatology, drug information, pain management, and child abuse. These are all topics of importance to pharmacy practice and pediatric care. The authors would encourage colleges to review the required didactic content of their curricula to evaluate the need to add such topics.

Despite identifying areas that may merit further attention from the colleges, advances have been made in the provision of pediatric experiential education. In 1991, only 70 percent of reporting bachelors degree programs in the U.S., Puerto Rico and Canada offered a rotation in pediatrics(3). Although our survey did not include Canadian pharmacy schools, only seven percent did not include a pediatric rotation, and all ultimately planned to. This is consistent with Bahal-O'Mara and Nahata's report that all of the 11 PharmD programs responding to their 1991 survey included a pediatric clerkship(3). Most programs have rotational experiences available in more than one area of pediatric practice. Despite this, only 41 percent of graduating students from the responding colleges would complete a pediatric rotation. Experiential training in pediatrics is required at 20 percent of the reporting programs; in those colleges offering only elective clerkships, 31 percent of students would complete a pediatric clerkship. The survey only determined how many students completed a rotation. Since information about the total capacity for each rotation was not requested, we are unable to assess the demand for elective pediatric rotations. Eleven of the programs submitted only projected data because they had not yet implemented their entry-level PharmD programs. Data from a proposed curriculum may differ from what will actually be taught in didactic or clerkship courses.

While it is encouraging that all entry-level PharmD programs offered or planned to offer at least an elective pediatric clerkship, less than half of the entry-level PharmD graduates will have completed such a rotation. As improving pediatric care reduces mortality in the neonate-through-adolescent population, it increases the number and complexity of acute and chronic pediatric medical problems. Children require special dosages and dosage regimens and exhibit unique pharmacokinetic challenges. Pharmacists should also be competent in the utilization of pediatric drug information resources. We would suggest that all pharmacy students receive at least some experiential training in the provision of pharmaceutical care to pediatric patients. While many colleges primarily utilize an inpatient setting, ambulatory pediatric care and specialty inpatient care represent possible areas for development or expansion.

CONCLUSION

All of the 54 colleges included in our data either had or were planning at least an elective clerkship experience in pediatrics; 20 percent of these colleges required a pediatric clerkship. Ninety-six percent of 47 reporting colleges utilized general pediatrics inpatient clerkships; 40 percent included ambulatory pediatric experiences. Pediatric topics commanded a mean of 16.7 hours of instruction in required courses in the 37 colleges which reported amounts of time spent on such topics; however, a number of pediatric topics which frequently impact pharmacy practice were identified which were infrequently included in required pediatric coursework. While "minimum" core content for pediatric education cannot be mandated because of the diversity of pharmacy education and the nature of our accreditation process, we would suggest a "benchmark" of at least 16 hours of required pediatric didactic exposure or its equivalent. Pharmaceutical care encompasses an often-significant pediatric population; the authors would suggest that core pediatric content needs to be identified and included in any pharmacy curriculum to assure the appropriate delivery of such care to the neonatal-through-adolescent population. The authors further suggest that the education of every pharmacist should include, at minimum, experience in the provision of direct pharmaceutical care to children and their caregivers.

Data reported from this survey may be useful to colleges when developing or revising pediatric didactic and clerkship experiences within entry-level PharmD programs.

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APPENDIX

Pediatric Pharmacy Advocacy Group (PPAG) & University of Nebraska Medical Center Survey of Pediatric Pharmacy Education in Entry Level PharmD Programs

- Does your college or university currently have an entry level doctor of pharmacy program? yes no
- If no, does your college or university have plans to implement one in the next 2 years? yes no

If you answered **no** to both of the first two questions, please do not complete this survey. Please include your name and address on the last page and return this survey in the enclosed envelope. A copy of the survey results will be mailed to you.

If you answered **yes** to either, or both of the first two questions, please complete this survey as it relates to your entry level doctor of pharmacy program.

Current or anticipated graduating class size for entry level PharmD program. _____

What is the status of your entry level PharmD curriculum?

- Revised in the last 5 years
- Currently revising
- Not currently revising, but plan to in next 5 years
- Not currently revising, and have no plans to in the next 5 years

If an elective pediatric course is offered, how many PharmD students take this course per year? _____

Clerkship section:

Is a pediatric clerkship rotation required? yes no

If not, how many entry level PharmD students take a elective pediatric rotation each year? _____

Please indicate the length of the pediatric clerkship
 _____ weeks
 _____ hours per week

- This reflects the current entry level PharmD clerkship rotations
- Or this reflects an approved curriculum plan, but students have not completed it.

For each pediatric clerkship area please indicate the current number of entry level PharmD students per year, or the anticipated number of students each site will accommodate in an approved curriculum plan.

- _____ General pediatric inpatient rotation
- _____ General pediatric ambulatory rotation
- _____ Pediatric intensive care
- _____ Neonatal intensive care
- _____ Pediatric hematology / oncology
- _____ Inpatient pediatric specialty (please specify type) _____
- _____ Inpatient pediatric specialty (please specify type) _____
- _____ Ambulatory pediatric specialty (please specify type) _____
- _____ Ambulatory pediatric specialty (please specify type) _____
- _____ Other: please specify _____
- _____ Other: _____

Please indicate the facilities that are utilized for the pediatric clerkship experiences, (check all that apply)

- Free standing pediatric facility
- Pediatric unit within another institution
- Home health care agency
- Pediatric clinic
- Other: (please specify) _____

Comments: _____

Reading assignments:

For each topic that is covered with Required Reading Assignments for either didactic classes or clinical clerkships in your entry level PharmD curriculum please estimate the number of minutes spent reading about each topic (please do not include discussion time about reading assignments). Please count only the time that is spent on topics specifically related to pediatric patients.

- This reflects the current required reading assignments
- Or this reflects an approved curriculum plan, but students have not yet completed it.

Required minutes	Elective minutes	Pediatric topics
_____	_____	Asthma / Respiratory disorders
_____	_____	Behavioral disorders
_____	_____	Cardiology/congenital heart disease
_____	_____	Cardiopulmonary resuscitation
_____	_____	Child abuse
_____	_____	Cystic Fibrosis
_____	_____	Dermatology
_____	_____	Diabetes
_____	_____	Diarrhea
_____	_____	Drug dosage and administration
_____	_____	Drug information
_____	_____	Endocrine/ metabolic disorders
_____	_____	Seizure disorders
_____	_____	Fever
_____	_____	Fluid and electrolyte therapy
_____	_____	Gastrointestinal disorders
_____	_____	Growth and development
_____	_____	Hematology
_____	_____	Immunizations

Comments: _____

Please include your name, address, and phone number. A copy of the results will be mailed to you.

Name/Position:

Address:

Phone number:

E-mail address (optional):

Minutes	Pediatric topics	Minutes	Pediatric topics
_____	Asthma / Respiratory disorders	_____	Infectious disease (meningitis)
_____	Behavioral disorders	_____	Infectious disease (pneumonias)
_____	Cardiology/ congenital heart disease	_____	Infectious disease (sepsis)
_____	Cardiopulmonary resuscitation	_____	Infectious disease (UTIs, others)
_____	Child abuse	_____	Management of poisoning
_____	Cystic Fibrosis	_____	Neonatology
_____	Dermatology	_____	Nutrition
_____	Diabetes	_____	Oncology
_____	Diarrhea	_____	Otitis media
_____	Drug dosage and administration	_____	Pain management
_____	Drug information	_____	Parasitic diseases (eg pinworm, head lice)
_____	Endocrine/ metabolic disorders	_____	Pharmacokinetics in children
_____	Seizure disorders	_____	Renal diseases
_____	Fever	_____	Transplant
_____	Fluid and electrolyte therapy	_____	Others-please specify
_____	Gastrointestinal disorders	_____	Other
_____	Growth and development	_____	Other
_____	Hematology	_____	Other
_____	Immunizations	_____	Other

Comments: _____

Didactic section: For each topic that is covered with didactic lectures, reading discussions, or case studies in your entry level PharmD curriculum please estimate the number of minutes spent on each topic. Please count only the time that is spent on topics specifically related to pediatric patients.

- This reflects the current didactic lectures, reading discussions, and case studies
- Or this reflects an approved curriculum plan, but students have not completed it.

Required minutes	Elective minutes	Pediatric topics
_____	_____	Infectious disease (meningitis)
_____	_____	Infectious disease (pneumonias)
_____	_____	Infectious disease (sepsis)
_____	_____	Infectious disease (UTIs, others)
_____	_____	Management of poisoning
_____	_____	Neonatology
_____	_____	Nutrition
_____	_____	Oncology
_____	_____	Otitis media
_____	_____	Pain management
_____	_____	Parasitic diseases (pinworm, head lice)
_____	_____	Pharmacokinetics in children
_____	_____	Renal diseases
_____	_____	Transplant
_____	_____	Others-please specify:
_____	_____	Other:
_____	_____	Other:
_____	_____	Other:
_____	_____	Other: