Evolution of Hospital-Based Pharmacy Teaching Programs from 1989 - 1998[1]

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This study evaluated hospital involvement in pharmacy education. Databases from four U.S. National Clinical Pharmacy Services Studies and the American Hospital Association permitted detailed trend analysis. The study population included acute care general medical surgical hospitals: 1989 n = 1174, 1992 n = 1597, 1995 n = 1102, 1998 n = 950. Clinical pharmacy services offered in 50 percent or more of PharmD affiliated hospitals in 1998 were: drug-use evaluation, inservice education, pharmacokinetic consultations, adverse drug reaction management, drug therapy monitoring, protocol management (aminoglycosides, nutrition, antibiotics, heparin, warfarin, and theophylline), nutrition team, and medication counseling. Patient-focused care programs varied among the hospitals by teaching affiliation in 1998 ($\chi 2$= 61.1, df=6, P<0.001). Drug information services and written admission medication histories declined. A consistent portfolio of clinical pharmacy services within the nation's teaching hospitals is lacking despite clinical and economic indicators that such services are valuable to patients and their payers.

INTRODUCTION

The modern version of Doctor of Pharmacy (PharmD) education began in the inpatient teaching hospital environment of the general medicine ward. Inpatient hospital rotations, which focus on the delivery of direct patient care pharmacy services, remain the foundation of most PharmD curricula. Pharmacy students' education and training in clinical pharmacy is often most efficiently delivered within the structure of teaching hospitals and their affiliated clinics. Therefore, the continued evaluation of the extent to which hospitals and colleges of pharmacy collaborate in the education and training of pharmacy students is of critical importance to educators and practitioners alike.

Colleges of pharmacy are struggling to keep pace with health care changes and concomitant pharmacy practice initiatives. Transition to the entry-level PharmD program combined with a decrease in the number of inpatient beds has substantially increased demand for expanded PharmD clerkship sites. Furthermore, educators and practitioners alike realize that PharmD education requires that students be actively trained in the delivery of direct patient care pharmacy services. Both clinical sites and clinical pharmacists (or clinical specialists) are essential ingredients for quality pharmacy education. Unfortunately, at the same time that hospitals are decreasing their inpatient census there is an acute shortage of pharmacists, particularly in specialized clinical roles. The increased demand for clerkships created by more students coupled with the downsizing of hospitals and a shortage of clinical pharmacists create a constant pressure to evaluate clerkship sites.

The National Clinical Pharmacy Services Study is the largest hospital-based pharmacy database in the United States. It is a continuing project designed to assess the evolution of hospital-based clinical pharmacy services and track the direct patient care involvement of pharmacists. National studies conducted in 1989, 1992, 1995 and 1998 provide a longitudinal database for comparison(1-4). This paper presents the 1998 teaching hospital data and evaluates changes in pharmacy teaching hospitals over the last nine years. It is the last National Clinical Pharmacy Services Study conducted prior to the switch to the entry-level PharmD program for many colleges. Thus, this report provides baseline data for evaluating the clinical services available to meet the increased clerkship demands in the year 2000 and beyond.

METHODS

Detailed methodologies of the 1989, 1992, 1995, and 1998 studies were previously published(1-4). A questionnaire was mailed to the director of pharmacy in each of the acute care, general-medical surgical hospitals or acute care pediatric hospitals that had 50 or more licensed beds according to the respective (by year) American Hospital Association's (AHA) abridged guide(5). Specialty hospitals such as rehabilitation and psychiatric hospitals were not included.

Definitions of questionnaire terms and subsequent groupings used in the analysis are given in the Appendix. Data analysis was based on grouping hospitals by six factors shown to be associated with statistically significant variation in the provision of clinical pharmacy services. Rationale for selecting these six factors was published previously(1-4).

In this report, hospital teaching affiliation was assigned to one of four exclusive categories: (*i*) hospitals affiliated with a school/college of pharmacy PharmD program; (*ii*) hospitals affiliated with a BS (Bachelor of Science) in Pharmacy program only; (*iii*) hospitals without a college of pharmacy affiliation but affiliation with other health care teaching programs (nonpharmacy teaching); and (*iv*) hospitals without any affiliation with

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Table I. Hospital size, pharmacy director's education, hospital ownership, and pharmacist's location by hospital teaching affiliation in 1998

	Hospitals teaching affiliation (No percent)				
	PharmD	BS Pharmacy only	Non-pharmacy teaching	Non-teaching	Total
Hospital Sizea					
Small	292(63)	110(80)	197(91)	127(96)	726(76)
Medium	122(26)	19(14)	17(8)	6(5)	164(17)
Large	49(11)	8(6)	3(1)	0(0)	60(6)
Pharmacy Director's Education[b]					
BS	142(31)	66(50)	112(53)	91(71)	411(44)
PharmD	117(26)	10(8)	44(21)	18(14)	189(20)
MS Pharmacy	96(21)	26(20)	30(14)	8(6)	160(17)
MBA, PhD, or nonpharmacy master's	98(22)	30(23)	27(13)	11(9)	166(18)
Hospital Ownership[c]					
Nonfederal govt	72(16)	12(9)	35(16)	31(23)	150(16)
Nongovt nonprofit	300(65)	109(80)	132(61)	77(58)	618(65)
For-profit	51(11)	13(10)	45(21)	24(18)	133(14)
Federal government	40(9)	3(2)	4(2)	1(1)	48(5)
Pharmacist's Location[d]					
Centralized	70(15)	36(27)	62(29)	49(37)	217(23)
Centralized with ward visits	147(32)	64(47)	122(56)	65(49)	398(42)
Decentralized	245(53)	36(27)	33(15)	18(14)	332(35)

[a] χ^2=100.2, df=6, P<0.001.
[b] χ^2=912, df=9, P<0.001.
[c] χ^2=52.0, df=9, P<0.001.
[d] χ^2=139.0, df=6, P<0.001.

any health care education program (nonteaching). Hospitals affiliated with both BS Pharmacy and PharmD programs were categorized as PharmD affiliated hospitals; as provision of services between these two groups of hospitals was previously shown not to differ significantly(4). Membership in the Council of Teaching Hospitals (COTH) was determined from the AHA database(5) applicable for the respective study year.

The Health Care Finance Administration's (HCFA) Medicare Case Mix Index for the respective year was used to assess the severity of illness for hospitalized patient(1-4). The HCFA case mix index is a relative measure of severity of illness for Medicare patients. It is based on diagnosis-related groups for Medicare patients and compares each hospital's cost per case relative to a national average for a given year. The HCFA Medicare case mix index correlates well with a hospital's overall case mix for Medicare and non-Medicare patients. All data were reduced to a machine-readable format. The SPSS 9.0 release was used to perform the analysis(6). Statistical tests used included simple descriptive statistics, chi-square analysis, and one way ANOVA preceding Scheffe multiple pairs comparison of the means(7). The a priori level of significance for all tests was 0.05. The 1998 data are compared to 1995 data to aid the reader's understanding of recent trends. Data from the 1989 and 1992 studies are provided when a longer trend analysis may be helpful to the reader. A detailed pharmacy teaching hospital analysis was published previously for the 1992 and 1995 studies(8,9). As a similar paper was not published for the 1989 study, this paper required determining certain descriptive data from the archived 1989 electronic database.

RESULTS

General

Detailed teaching affiliation data was available for 950 acute care general medical surgical and pediatric hospitals through the 1998 survey. Respondents and nonrespondents did not differ by hospital size but did differ by geographic region and hospital ownership(4).

Of the 950 hospitals in the 1998 survey, 63 percent had a teaching affiliation with a college (or school) of pharmacy (defined as present if at least one student was trained in the hospital in the previous year). Among pharmacy college affiliated hospitals, 16 percent were a member of the COTH versus two percent of nonpharmacy teaching hospitals. This distribution was unchanged from 1995.

Of the 1998 hospital respondents that were affiliated with a college of pharmacy, 75 percent had a written plan for expanding clinical services or implementing pharmaceutical care. However, only 54 percent of hospitals without college of pharmacy affiliation had such plans. A written ethics code for pharmacists was required in 39 percent of all 1998 hospitals regardless of college affiliation; which increased from 31 percent in 1995. In 1998, pharmacists had the authority to make entries into the medical record documenting their clinical activities in 85 percent of college affiliated hospitals versus 70 percent of hospitals not affiliated with a college of pharmacy. In 1998, a medication error reporting system was operational in 96 percent of both college of pharmacy affiliated and hospitals without pharmacy college affiliation.

Table I shows the variation in 1998 hospital teaching affiliation by factors known to be associated with variation in the provision of clinical pharmacy services. PharmD programs predominately used a mix of small and medium-sized hospitals. BS Pharmacy programs had many more affiliations with small-sized hospitals than medium or large-sized hospitals.

Sixty-nine percent of PharmD affiliated hospitals employed a director of pharmacy who had earned an advanced degree. This was observed in only 51 percent of BS Pharmacy affiliated hospitals. Both PharmD and BS Pharmacy programs

Table II. Variation in provision of clinical pharmacy services by hospital teaching affiliation in 1998 compared with 1995

Inpatient clinical services	Number (percent of hospitals) All (n=950)	PharmD (n=463)	BS Pharmacy only (n=137)	Nonpharmacy teaching (n=217)	Nonteaching (n=133)	Significance
Drug therapy monitoring	514(54) [2][a]	292(63) [-1]	68(50) [-3]	94(43) [1]	60(45) [7]	χ^2=30.6, df=3, *P*<0.001
Drug-use evaluation	899(95) [0]	450(97) [1]	132(96) [2]	200(92) [-3]	117(88) [-7]	χ^2=21.0, df=3, *P*<0.001
Inservice or continuing ed	635(67) [-6]	355(77) [-11]	81(59) [-11]	137(63) [-2]	62(47) [-12]	χ^2=49.8, df=3, *P*<0.001
Adverse drug reaction mgmt	671(71) [2]	357(77) [4]	86(63) [-7]	150(69) [1]	78(59) [1]	χ^2=22.9, df=3, *P*<0.001
Pharmacokinetics consultation	759(80) [9]	413(89) [4]	103(75) [9]	167(77) [14]	76(57) [0]	χ^2=70.9, df=3, *P*<0.001
Drug therapy protocol mgmt	661(70) [18]	358(77) [16]	85(62) [12]	149(69) [20]	69(52) [10]	χ^2=36.6, df=3, *P*<0.001
Parenteral/enteral nutrition team	428(45) [3]	246(53) [-4]	49(36) [2]	86(40) [2]	47(35) [7]	χ^2=24.6, df=3, *P*<0.001
Medication Counseling	458(48) [3]	279(60) [3]	59(43) [-7]	78(36) [5]	42(32) [2]	χ^2=56.2, df=3, *P*<0.001
Cardiopulmonary arrest team	302(32) [-2]	167(36) [-2]	36(26) [-5]	69(32) [1]	30(23) [-7]	χ^2=11.1, df=3, *P*<0.011
Drug information	255(27) [0]	164(35) [-5]	19(14) [-4]	49(23) [-1]	23(17) [-3]	χ^2=37.3, df=3, *P*<0.001
Rounds	234(25) [1]	173(37) [-11]	24(18) [3]	25(12) [2]	12(9) [5]	χ^2=81.7, df=3, *P*<0.001
Clinical research	131(14) [0]	115(25) [-7]	4(3) [-6]	9(4) [0]	3(2) [1]	χ^2=93.0, df=3, *P*<0.001
Poison Information	148(16) [-1]	88(19) [-8]	14(10) [-2]	37(17) [4]	9(7) [-3]	χ^2=15.3, df=3, *P*=0.002
Written admission medication histories	43(5) [1]	27(6) [-1]	5(4) [2]	10(5) [3]	1(1) [0]	χ^2= 6.5, df=3, *P* =NS
Provide pharmaceutical care[b]	490(54)	286(64)	61(47)	91(44)	52(43)	χ^2=34.4, df=3, *P* <0.001

[a] Numbers in brackets reflect differences between percents in 1998 and percents in 1995. Minus signs indicate decreases in 1998.
[b] n's for this row are: 906, 448, 130, 207 and 121, respectively.

relied heavily on nonprofit hospitals. The percentage of affiliations with for-profit hospitals changed little over the nine-year study period with about 10 percent of for-profit hospitals participating in PharmD education. While 53 percent of PharmD affiliated hospitals in 1998 had decentralized pharmacists, this dropped to only 27 percent of BS Pharmacy affiliated hospitals. The percentages of PharmD hospitals using the decentralized or centralized staff pharmacist model did not change significantly since the 1989 study. BS Pharmacy affiliated hospitals most often used the model where pharmacists are based centrally but visit the patient care units at least daily.

Specific Inpatient Clinical Pharmacy Services

Of the fourteen specific inpatient clinical pharmacy services studied, all were more likely to be present in hospitals with a college of pharmacy teaching affiliation (PharmD and BS Pharmacy hospitals combined) than in those hospitals without a college of pharmacy teaching affiliation. Table II shows the variation in the presence of inpatient clinical pharmacy services when hospitals were assigned to one of the four groups of teaching affiliation: PharmD affiliated, BS Pharmacy only affiliated, nonpharmacy teaching, and nonteaching. A trend was observed in which the clinical pharmacy service was most often provided in hospitals affiliated with a PharmD program, followed by the nonpharmacy teaching hospitals, followed by hospitals affiliated only with a BS Pharmacy program, followed by the nonteaching hospitals.

Nine of the 14 services studied were "patient-specific" clinical pharmacy services: drug therapy monitoring, adverse drug reaction (ADR) management, pharmacokinetics consultations, drug therapy protocol management, parenteral enteral nutrition team, medication counseling, cardiopulmonary arrest team, rounds, and written admission medication histories. These services generally required the pharmacist to prospectively apply patient-specific data to direct patient care activities. Consistent with the 1989, 1992 and 1995 studies, all nine of these services were offered more often in PharmD affiliated hospitals than BS Pharmacy affiliated hospitals in the 1998 study.

When defining a "core" clinical pharmacy service as one that is offered in 50 percent or more of hospitals, the core services offered in PharmD affiliated hospitals in 1998 included: drug-use evaluation, inservice education, pharmacokinetics consultations, ADR management, drug therapy monitoring, protocol management, nutrition team membership, and medication counseling. These "core" services were identical to the "core" services identified in both 1992 and 1995 studies. Medication counseling increased to a core service between 1992 and 1995, otherwise there was no expansion of core services during the nine-year study period. Within all PharmD affiliated hospitals, seven clinical services increased substantially during the nine-year study period. Four services remained unchanged and three services actually declined in percentage of provider hospitals (Figures 1 and 2) over the nine years. Pharmacist conducted written admission medication histories, known to have a statistically significant association with reduced mortality rates in U.S. hospitals(10), were available in only five percent of PharmD affiliated hospital respondents in 1998; steadily decreasing during the nine-year study period. Written admission medication histories remain the least offered clinical service studied.

Likewise, pharmacist participation on a cardiopulmonary arrest resuscitation (CPR) team showed a statistically significant association with a decrease in hospital mortality rates(10), yet, during the nine-year study period pharmacists did not increase their involvement in CPR teams past 35-39 percent of PharmD affiliated hospitals (Figure 2). The two other clinical pharmacy services demonstrated to have a statistically significant association with decreased hospital mortality rates were clinical research and drug information(10). Clinical research activity, beyond investigational drug pharmacist functions, declined in pharmacist involvement over the last six years within PharmD affiliated hospitals. Drug information services increased during the early 1990s but decreased back to 1989

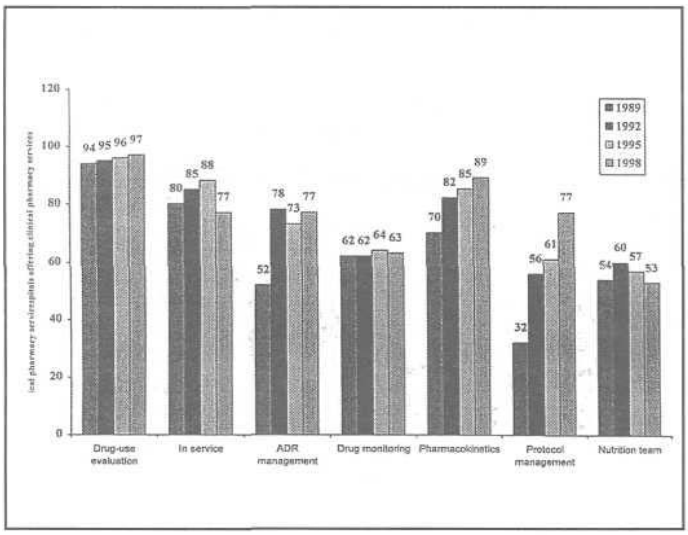

Fig. 1. Growth of clinical pharmacy services in PharmD-affiliated teaching hopsitals from 1988-1992-1995-1998 (1989 data from ref. 1; 1992 data from ref. 2; 1995 data from ref. 3).

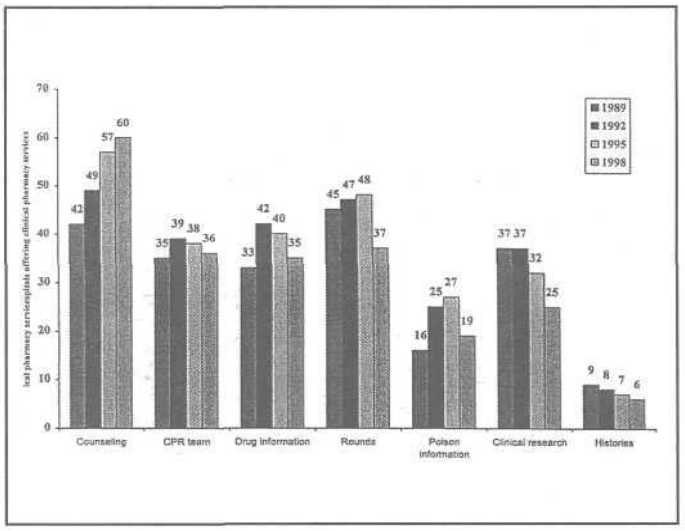

Fig. 2. Growth of clinical pharmacy services in PharmD-affiliated teaching hopsitals from 1988-1992-1995-1998 (1989 data from ref. 1; 1992 data from ref 2; 1995 data from ref. 3).

Table III. Protocol management by hospital teaching affiliation in 1998

		Hospitals teaching affiliation (percent)				
	All (n=950)	**PharmD (n=463)**	**BS Pharmacy only (n=137)**	**Non-pharmacy teaching (n=217)**	**Non-teaching (n=133)**	**Significance**
Pharmacist provides protocol mgmt	661(70)	358(77)	85(62)	149(69)	69(52)	χ^2=36.6, df=3, *P*<0.001
Aminoglycosides	599(91)[a]	325(91)[a]	80(94)[a]	131(88)[a]	63(91)[a]	χ^2=2.6, df=3, *P* =NS
Parenteral nutrition	331(50)	188(53)	31(37)	71(48)	41(59)	χ^2=9.9, df=3,*P* =0.019
Antibiotic therapy	316(48)	179(50)	41(48)	61(41)	35(51)	χ^2=3.7, df=3, *P* =NS
Theophylline/ Aminophyllme	179(27)	95(27)	17(20)	40(27)	27(39)	χ^2=7.3, df=3, *P* =NS
Heparin	310(47)	173(48)	33(39)	71(48)	33(48)	χ^2=2.6, df=3, *P* =NS
Pain therapy	135(20)	84(24)	8(9)	30(20)	13(19)	χ^2=8.5, df=3, *P* =0.037
Warfarin	202(31)	132(37)	17(20)	35(24)	18(26)	χ^2=15.3, df=3, *P* =0.002
Antibiotic prophylaxis	91(14)	47(13)	12(14)	23(15)	9(13)	χ^2=0.5,df=3, *P*=NS
Digoxin	83(13)	50(14)	10(12)	15(10)	8(12)	χ^2=1.6, df=3, *P*=NS
Enteral nutrition	77(12)	46(13)	7(8)	15(10)	9(13)	χ^2=2.0, df=3, *P*=NS
Antiepileptic agents	61(9)	39(11)	5(6)	10(7)	7(10)	χ^2=3.5, df=3, *P*=NS
Diabetes	60(9)	38(11)	3(4)	12(8)	7(10)	χ^2=4.5, df=3, *P* =NS
Lithium	41(6)	28(8)	3(4)	6(4)	4(6)	NA[b]
Lidocaine	22(3)	10(3)	1(1)	9(6)	2(3)	NA[b]
Hypertensive medications	48(7)	34(10)	3(4)	8(5)	3(4)	χ^2=6.1,df=3, *P*=NS
Cyclosporine	18(3)	11(3)	0(0)	5(3)	2(3)	NA[b]
Cholesterol lowering drugs	61(9)	44(12)	6(7)	6(4)	5(7)	χ^2=9.6, df=3, *P* =0.022
Antiarrhythmics	35(5)	24(7)	2(2)	6(4)	3(4)	NA[b]
Asthma care	49(7)	32(9)	2(2)	9(6)	6(9)	χ^2=5.0, df=3, *P*=NS

[a] Number and percent of hospitals within each teaching affiliation category in which pharmacists manage designated type of drug therapy.
[b] χ^2 analysis is not applicable.

levels by 1998 (35 percent of PharmD affiliated hospitals).

Four clinical pharmacy services were associated with reduced hospital drug costs: inservice education, drug information service, drug protocol management, and admission histories(11). The percentage of PharmD affiliated hospitals offering pharmacist inservices stayed relatively the same over the nine-year study period with a small decline in hospitals responding in 1998 (77 percent) compared to hospitals responding in 1989 (80 percent). In stark contrast, drug therapy protocol management, steadily increased its penetration in PharmD affiliated hospitals rising from 32 percent of hospitals responding in 1989 to 77 percent of hospitals respondents in 1998.

Six clinical pharmacy services were associated with a statistically significant decrease in total hospital cost of care: drug use evaluation (DUE), drug information service, ADR monitoring, drug therapy protocol management, medical rounds, and medication admission histories(12). Each of these has also been associated with either reduced hospital mortality or reduced drug costs except for drug use evaluation, ADR monitoring and rounds. Within PharmD affiliated hospitals, pharmacists' participation in ADR management (defined as occur-

Table IV. Patient populations receiving pharmaceutical care by hospital teaching affiliation in 1998.

		Hospitals teaching affiliation (percent)				
	All (n=950)	PharmD (n=463)	BS Pharmacy only (n=137)	Non-pharmacy teaching (n=217)	Non-teaching (n=133)	Significance
Pharmaceutical care provided by pharmacists	490(54)	286(64)	61(47)	91(44)	52(43)	χ^2=34.4, df=3, *P* <0.001
All patients	231(47)[a]	109(38)[a]	34(56)[a]	54(59)[a]	34(65)[a]	χ^2=23.5, df=3, *P* <0.001
Pediatrics	127(26)	80(28)	11(18)	28(31)	8(15)	χ^2=6.7, df=3, *P* =NS
Geriatrics	155(32)	93(33)	16(26)	35(39)	11(21)	χ^2=5.5, df=3, *P* =NS
Intensive care	218(45)	148(52)	20(33)	38(42)	12(23)	χ^2=19.4, df=3, *P* <0.001
Oncology	171(35)	125(44)	12(20)	23(25)	11(21)	χ^2=24.0, df=3 *P* <0.001
Transplant	40(8)	33(12)	1(2)	6(7)	0(0)	χ^2=12.7, df=3, *P* =0.005
Psychiatry	62(13)	39(14)	9(15)	9(10)	5(10)	χ^2=1.6, df=3, *P*=NS
General surgery	109(22)	69(24)	10(16)	24(26)	6(12)	χ^2=6.1,df=3, *P*=NS
General medicine	199(41)	129(45)	19(31)	40(44)	11(21)	χ^2=13.2, df=3, *P* =0.004
Diabetes	132(27)	81(28)	13(21)	29(32)	9(17)	χ^2=4.8,df=3, *P* =NS
Cardiovascular	190(39)	129(45)	21(34)	31(34)	9(17)	χ^2=16.3,df=3, *P* =0.001
Respiratory	107(22)	61(21)	10(16)	27(30)	9(17)	χ^2=5.0, df=3, *P* =NS
Renal	146(30)	90(32)	15(25)	31(34)	10(19)	χ^2=4.7, df=3, *P* =NS
HIV	82(17)	61(21)	4(7)	14(15)	3(6)	χ^2=13.5, df=3, *P* =0.004
Other	61(12)	53(19)	2(3)	4(4)	2(4)	χ^2=23.4,df=3, *P* =0.001

[a] Number and percent of hospitals within each teaching category which provide pharmaceutical care to designated patient populations.

Table V. Clinical pharmacy services included in pharmaceutical care model by hospital teaching affiliation in 1998

		Hospitals teaching affiliation (percent)				
Services routinely incorporated	All (n=950)	PharmD (n=463)	BS Pharmacy only (n=137)	Non-pharmacy teaching (n=217)	Non-teaching (n=133)	Significance
Drug therapy monitoring	744(78)	386(83)	104(76)	159(73)	95(71)	χ^2=14.4,df=3, *P* =0.002
Pharmacokinetic consultations	766(81)	416(90)	101(74)	169(78)	80(60)	χ^2=66.2, df=3, *P*<0.001
Parenteral/enteral nutrition monitoring	553(58)	297(64)	76(56)	117(54)	63(47)	χ^2=15.2,df=3, *P* =0.002
Medication counseling	528(56)	303(65)	72(53)	93(43)	60(45)	χ^2=38.9, df=3, *P*<0.001
Rounds with medical team	254(27)	184(40)	30(22)	28(13)	12(9)	χ^2=84.1,df=3, *P*<0.001
Written medical history	32(3)	22(5)	4(3)	5(2)	1(1)	NA[a]
ADR management	735(77)	384(83)	100(73)	165(76)	86(65)	χ^2=22.2,df=3, *P*<0.001
Protocol management	475(50)	270(58)	59(43)	101(47)	45(34)	χ^2=30.4,df=3, *P*<0.001
CPR team response	288(30)	161(35)	35(26)	61(28)	31(23)	χ^2=9.4, df=3, *P*<0.024
Basic physical assessment	28(3)	26(6)	0(0)	0(0)	2(2)	NA[a]
Wellness assessment	5(1)	5(1)	0(0)	0(0)	0(0)	NA[a]
Immunization assessment	17(2)	14(3)	1(1)	2(1)	0(0)	NA[a]
Herbal remedies	61(6)	39(8)	3(2)	14(7)	5(4)	χ^2=8.7, df=3, *P*=0.033
Patient interviews	132(14)	96(21)	7(5)	20(9)	9(7)	χ^2=36.6,df=3, *P* <0.001

[a]χ^2 analysis not applicable.

ring while the patient was still hospitalized) increased dramatically between 1989 (52 percent of hospitals) and 1992 (78 percent) where it has remained steady. In contrast, the percentage of PharmD affiliated hospitals in which pharmacists participated in any set of rounds declined precipitously between 1995 (48 percent of hospitals) and 1998 (37 percent of hospitals). The two clinical pharmacy services associated with all three major outcomes variables (*i.e.* reduced hospital mortality, reduced drug costs, and reduced total hospital cost of care) were drug information services and written admission medication histories. Neither of these is a core clinical pharmacy service, and both have steadily decreased in percentage of PharmD affiliated hospitals offering this service during the last six to nine years.

Pharmacists' participation in drug therapy protocol management, known to lower drug costs and overall hospital health care costs, provides pharmacy students the opportunity to create, implement, and monitor patient care plans. Of the 18 specific drugs, drug classes or disease states queried, significant differences according to teaching affiliation were observed in only four therapeutic areas: parenteral nutrition, pain therapy, warfarin therapy, and cholesterol lowering therapy (Table III). Thus, a pharmacy student completing PharmD clerkships in 1998 would most likely have gained experience in aminoglycoside management (91 percent of hospitals), parenteral nutrition management (53 percent of hospitals), antibiotic therapy management (50 percent of hospitals) and heparin therapy management (48 percent of hospitals).

Table VI. Patient focused care involvement by hospital teaching affiliation in 1998

Hospital's approach to patient care[a]	Hospitals teaching affiliation (No. percent) All (n=944)	PharmD (n=461)	BS Pharmacy only (n=136)	Non-pharmacy teaching (n=217)	Non-teaching (n=130)
Traditional department structure only	256(27)	105(23)	35(26)	56(26)	60(46)
Traditional department structure; starting patient-focused care	431(46)	188(41)	73(54)	122(56)	48(37)
Predominantly patient-focused care	257(27)	168(36)	28(21)	39(18)	22(17)

[a] χ^2=611, df=6, P<0.001

Table VII. Ambulatory patient care by hospital teaching affiliation in 1998

Patient populations	Hospitals teaching affiliation (percent) All (n=950)	PharmD (n=463)	BS Pharmacy only (n=137)	Non-pharmacy teaching (n=217)	Non-teaching (n=133)	Significance
Oncology	146(15)	95(21)	15(11)	25(12)	11(8)	χ^2=19.1,df=3, P <0.001
Anticoagulation	130(14)	109(24)	9(7)	9(4)	3(2)	χ^2=75.4, df=3, P <0.001
Diabetes	104(11)	76(16)	12(9)	8(4)	8(6)	χ^2=30.0, df=3, P <0.001
Others	110(12)	92(20)	9(7)	7(3)	2(2)	χ^2=62.4, df=3, P <0.001

Table VIII. HCFA case mix index by hospital teaching affiliation in 1998[a]

	Mean ± SD[b]
PharmD (n=404)	1.444 ±0.25[c,d,e]
BS Pharmacy only (n=131)	1.351 ±0.22[c,f]
Nonpharmacy teaching (n=207)	1.313 ±0.21[d]
Nonteaching (n=128)	1.248 ±0.21[e,f]

[a] HCFA Case Mix Index available for 870 hospitals.

[b] One-way ANOVA preceding Scheffé multiple-pairs comparison of the mean $F_{3,866}$= 30.5, P<0.0001.

[c-f] Values with like superscripts differ significantly at P<0.05.

Pharmaceutical Care

For the first time, the 1995 National Clinical Pharmacy Services Study asked respondents to indicate their pharmacists' involvement in provision of pharmaceutical care. This was again queried in 1998 (Table IV). Pharmaceutical care was defined as care provided directly to individuals using a systematic, comprehensive process to identify, resolve, and prevent drug related problems in order to achieve definite drug therapy outcomes. Pharmaceutical care was further defined as care that is comprehensive, prospective, and patient specific; usually provided in partnership with other health care professionals. In 1998, two more items determined to what extent the more comprehensive pharmaceutical care style of practice had been adopted by the nation's teaching hospitals, and, what patient populations received pharmaceutical care. While 64 percent of PharmD affiliated hospitals provided pharmaceutical care to some or all patients, this fell to 47 percent of BS Pharmacy affiliated hospitals, 44 percent of nonpharmacy teaching hospitals, and 43 percent of nonteaching hospitals.

In 1998 respondents indicated the patient populations covered within their pharmaceutical care programs (Table IV). Regardless of college of pharmacy affiliation, the three most common specific patient populations targeted to receive pharmaceutical care were intensive care patients, general medicine patients, and cardiovascular patients. In both PharmD affiliated and BS Pharmacy affiliated hospitals, the next most often targeted patient types were geriatrics, oncology, and renal patients. Between 1992 and 1995, pharmaceutical care programs focused on similar patient populations as listed above.

The inclusion of specific clinical pharmacy services within the pharmaceutical care model differed significantly among all different teaching affiliations (Table V). In the 1998 study, more than one half of the PharmD affiliated hospital respondents indicated that pharmaceutical care included pharmacists performing: drug therapy monitoring, pharmacokinetic consultations, parenteral nutrition monitoring, ADR management, medication counseling and protocol management. Pharmacists' participation in medical team rounds, was included within pharmaceutical care in only 40 percent of PharmD affiliated hospitals and 22 percent of BS Pharmacy affiliated hospitals in 1998. Several "new" clinical pharmacy services identified through observations of the authors and literature reports, were rarely a component function of hospital-based pharmaceutical care in 1998: basic physical assessment, well-ness assessment, immunization assessment, and herbal remedies assessment. However, pharmacists conducted one on one patient interviews in 21 percent of pharmaceutical care programs in 1998.

Patient-Focused Care

Like the National Clinical Pharmacy Services Study in 1995, in 1998 pharmacists' involvement in patient-focused care was defined as being characterized by decentralization of services, interdisciplinary collaboration, cross training, and some degree of work redesign. Table VI reveals a significant difference in the adoption of the patient-focused care model among hospitals of varying college of pharmacy teaching affiliation. The percentage of PharmD affiliated hospitals which predominantly used the patient-focused care model rose from

24 percent in 1995 to 36 percent in 1998. However, patient-focused care programs remained constant within the BS Pharmacy and nonpharmacy teaching hospitals, suggesting a synergy between increased teaching involvement and adoption of the patient-focused care model.

Ambulatory Clinics

Table VII shows the patient populations cared for by pharmacists in hospital affiliated ambulatory clinics in 1998. The four most common types of clinic populations or clinic activity in PharmD affiliated hospitals were oncology, anticoagulation, diabetes, and medication refills. These were identical to the populations identified in the 1995 study.

Case Mix Index

Each hospital's severity of illness was assessed by its case mix index assigned by HCFA. The higher the case mix index, the greater the hospital's proportion of severely ill Medicare patients. Pharmacy teaching hospitals had more severely ill patients as reflected by a higher HCFA case mix index in 1998 (Table VIII). The mean case index was significantly higher for PharmD affiliated hospitals than for the three other hospital groups. Similarly, the case mix for BS Pharmacy affiliated hospitals was significantly greater than the case mix for nonteaching hospitals (hospitals without any teaching involvement). These trends were identical to those observed in 1995. Although the mean HCFA case mix index decreased from 1.501 ± 0.24 in the 1995 PharmD affiliated hospitals to 1.444 ± 0.25 in the 1998 hospitals, it seems unlikely that the patient acuity actually declined in this period given continual shortening in lengths of stay and a general observation that hospitalized patients are increasingly more ill.

Summary of Structure, Process, and Outcomes of Clinical Services in PharmD Teaching Hospitals

Structure Characteristics. This nine-year study provides guidance to deans and department chairs in identifying, developing, and supporting partnerships with hospitals that are essential for PharmD clerkship instruction. Table IX summarizes the structure and process characteristics common to at least one half of the PharmD teaching hospitals in 1998. Thus, these hospital and pharmacy department structural characteristics describe the "laboratory resources" available for PharmD clerkship instruction. More than 60 percent of the nation's small sized hospitals were affiliated with a college of pharmacy. Likewise, more than 60 percent of the nongovernment nonprofit hospitals had an active college affiliation. In 69 percent of the nation's PharmD teaching hospitals, the director of pharmacy had earned an advanced degree. Finally, the severity of patient illness in the PharmD teaching hospitals was significantly greater than in the other types of teaching hospitals, thus students were exposed to more severely ill patients than normally encountered.

Process Characteristics. Table IX summarizes the planning and offering of clinical pharmacy services provided in at 50 percent or more of the PharmD teaching hospitals. These are the patient care processes that PharmD students may be exposed to during their hospital-clerkship instruction. Slightly more than one-half (53 percent) of the PharmD teaching hospitals used a decentralized pharmacist model. The nine clinical pharmacy services offered in at least one half of the PharmD teaching hospitals also describe the skill set expected by potential employers of graduate pharmacists.

Table IX. Summary of hospital and pharmacy department structure and process characteristics present in at least 50 percent of hospitals affiliated with PharmD teaching programs in 1998

Hospital Characteristics
Small Hospitals
Nongovernment Nonprofit Hospitals
Decentralized Pharmacists
More Severely 111 Patients (Higher Case Mix)
Pharmacy Characteristics
Pharmacy Director with an Advanced Degree
Written Plan for Expanding Clinical Pharmacy Services
Written Plan for Implementing Pharmaceutical Care
Pharmacists May Make Entries Into the Medical Record
Documenting Their Clinical Activities
Clinical Pharmacy Services
Drug Therapy Monitoring
Drug-Use Evaluation
Inservice or Continuing Education
Adverse Drug Reaction Management
Pharmacokinetic Consultation
Parenteral Nutrition Team
Drug Therapy Protocol Management
Aminoglycoside Management
Parenteral Nutrition
Medication Counseling
Provides Pharmaceutical Care

Outcomes. Although the structure and process of PharmD teaching hospitals and their pharmacy departments are important in defining resources for PharmD clerkship instruction, they do not always reflect those pharmacist activities known to positively affect major health care outcomes. None of the clinical services associated with decreased mortality rates(10), (drug information service, clinical research, CPR team participation, and written admission medication histories) were offered in more than one-third of the PharmD teaching hospitals. Two of the four clinical services associated with decreased drug costs(11), inservice education and drug therapy protocol management, were offered in almost 70 percent of the PharmD teaching hospitals. However the other two, drug information services and written admission medication histories, were offered respectively in only 27 percent and five percent of PharmD teaching hospitals. Of the six clinical pharmacy services associated with decreased overall health care costs(12), three were commonly offered (drug-use evaluation, ADR management, and drug therapy protocol management). While the other three (drug information service, medical rounds, and written medication histories) were offered in one-fourth or fewer PharmD teaching hospitals. Written medication histories, associated with lower mortality rates, lower drug costs, and lower total cost of care, were performed in only five percent of the PharmD teaching hospitals(10-12). And even within these hospitals, written medication histories were usually performed for a small number of patients. Structure, process and outcomes together should define the portfolio of clinical services offered in teaching hospitals.

DISCUSSION

This paper characterizes the type of clinical pharmacy services offered in four groups of hospitals according to their affiliation with a PharmD program, a BS Pharmacy program only, nonpharmacy health care education programs, and hospitals without involvement in training health care professionals. The trends over a nine-year period are analyzed. The involvement of the for-prof-

it hospitals in pharmacy education remains low. For-profit hospitals rarely share the mutual responsibility of educating future pharmacists. During the nine-year study period, increasing involvement of small and mid-sized hospitals was observed, corresponding with a movement to decentralize clerkship instruction away from the traditional larger academic health sciences center.

Throughout the nine-year study period, more extensive and a broader array of clinical pharmacy services were found in hospitals where the director had earned an advanced degree. Deans and department chairs may wish to develop specialized programs with directors who have not had advanced education so that they truly understand the needs of PharmD clerkship education. Likewise, these directors will likely seek college support in upgrading their core clinical pharmacy services to a level like other PharmD program affiliated hospitals.

Although it is often purported to be standard service, decentralized pharmacy services are only provided in about one-half of PharmD affiliated hospitals. It is unlikely that significantly more decentralized pharmacist models will be introduced in the near future, secondary to rising salary costs, shortage of pharmacists, and a general cost reduction mode within hospitals. This dilemma is problematic. Pharmacy students need to learn the decentralized practice model. Yet, colleges must place students in hospitals using centralized systems. Similarly, pharmacy students must learn how to impact drug therapy decisions within the interdisciplinary medical team rounding structure. Yet, pharmacists round with medical teams in only one-fourth of all PharmD teaching hospitals. Thus, students must experience systems that impact drug therapy outcomes without the presence of a medical team rounding model. This is often a steep learning curve for young practitioners, especially if all of their hospital clinical clerkships were based on the medical team rounding model usually found only in larger academic health sciences centers.

Clearly, clinical pharmacy services within the nation's teaching hospitals are not standardized. Yet, educators are unable to demand a consistent portfolio of clinical pharmacy services without significantly underwriting the costs within the health care system. The nation's teaching hospitals are in financial crisis. Provision of indigent care, managed care, marketplace competition, government cutbacks affecting medical education, costs of teaching itself, research support, and higher patient acuity all contribute to a dismal financial posture for the academic health science centers. The reduction of Medicare Disproportionate Share combined with implementation of a Medicare Outpatient Prospective Payment System will more than double the estimated per year losses for teaching hospitals compared to nonteaching hospitals(13). The Association of American Medical Colleges determined that in 1997, the median total margin for a typical major teaching hospital was 2.9 percent compared to margins of 5.4 percent and 6.1 percent for other teaching and non-teaching hospitals respectively(13). In 2002, the median total margin is projected to drop to zero; with one-half of all major teaching hospitals facing a negative total margin. Teaching hospitals face this crisis by cutting back services to the community, indigent care, clinical research activities, and education and training for health professions students. Thus, the teaching hospitals are reluctant to support the personnel costs associated with expanded clinical pharmacy services.

Managed care's effect on medical education prompted noteworthy editorials by medical leaders and politicians alike(14,15). Academic health science centers uniformly share three core missions: education, research and patient care. They compete in an industry with other types of hospitals and ambulatory sites who have only one core mission; patient care. The hostile health care economic climate has prompted medical leaders to coin the term "managed cash" organizations in place of managed care organizations(16)

The negative effects of managed care and health care economics reported for medical education appear applicable to pharmacy education. Practitioners are burdened with too much paperwork, increasing patient care workloads, and more scrutiny of practice leaving little time for teaching students and even residents. Shorter lengths of stay coupled with ambulatory shifts away from the teaching hospitals mean that students receive less exposure to acutely ill patients and less time to observe the course of drug therapy and its true outcomes(17). Medical education has responded to these changes by increasingly using community-based physicians to provide preceptorships throughout the four-year medical curriculum. However, pharmacy has few community-based pharmacists who provide routine clinical pharmacy services essential for the education and experiential training of the PharmD student. Ambulatory clinical pharmacy practitioners are frequently under the same time pressure to meet industry standards (e.g. 15 minutes per patient) as are their medical colleagues. Both medicine and pharmacy rely upon the care of ill patients to train their students, therefore, it seems reasonable that pharmacy join medicine's organizational and political struggle to restructure the national policies for payment of health care professionals' education and training. It is important to point out to policy makers that teaching hospitals can demonstrate better patient care outcomes, such as improved survival from hip fractures(18,19). The presence of clinical pharmacy services can also improve survival outcomes, as well as reduce drug costs and total cost of hospital care(10-12). Pharmacy directors must share this convincing data with their financial officers. Deans and faculty must in turn encourage pharmacy directors to place their resources in clinical services. The pharmacy profession still does not have a clear, consistent, and easily identifiable practice methodology of pharmaceutical care within its teaching hospitals. This nine-year study has provided a potential roadmap to define this practice methodology(20) (1).

LIMITATIONS

Several limitations of this study deserve mentioning. The data obtained over the nine-year period were from acute care general medical-surgical hospitals and pediatric hospitals and should not be extrapolated to other types of hospitals. The response rate was acceptable; however, it steadily declined over the nine-year period. The possibility of nonresponder biases remains. However, this study surveyed the entire population of the United States hospitals in 1992, 1995, and 1998, thereby reducing sampling bias. The identity of respondents remains confidential, therefore, the crossover of respondents among the 4 survey periods was not analyzed. Definitions of clinical services, patient-focused care, and pharmaceutical care were carefully crafted to limit variation in interpretation. Definitions held constant throughout the years; however, interpretation of some definitions may have varied. Confounding factors, such as affiliation with an entry-level PharmD program versus a post BS PharmD program cannot be determined from this study. Likewise, the interaction among the hospital classification groups (geographic location, director's education, etc.) could not be assessed. Results are presented as associations and not cause and effect relationships.

SUMMARY

Despite the introduction of alternative ambulatory sites, most pharmacy clerkship programs are heavily dependent on hospitals

and their staff for experiential education. Pharmacy practice faculty, clinical specialists, and hospital pharmacy staif strive to provide specific skill development for students. Thus, it is a joint responsibility of faculty and adjunct clinical preceptors to develop students' direct patient care skills and assess skill development in the context of day to day patient care. A portfolio of clinical pharmacy services in which students obtain experience is, therefore, closely linked to the portfolio of experiences offered within the clerkship program. These experiences hopefully mirror, or exceed, the core clinical pharmacy services offered in hospitals during the 1990s: drug use evaluation, inservice education, ADR management, drug monitoring, clinical pharmacokinetics, drug therapy protocol management, nutrition team participation, and patient counseling. However, other critical services such as admission medication histories and provision of a formal drug information service are so sporadically offered that students completing hospital-based clerkships will rarely be exposed to this service. Thus, students may not fully develop skills known to save lives, save drug costs, and save total health care costs(21). As costs continue to pressure hospitals, it is imperative that pharmacy education and hospital pharmacy work together with influential politicians and medical leaders. Local, state, and national initiatives should assure that tomorrow's pharmacist (as well as physician and nurse) meet tomorrow's patient's needs by training in the active patient care roles that affect both lives and economics. Some of this training will occur in those academic health sciences centers fortunate enough to survive economic pressures(21). A large percentage of this training must occur outside the academic health sciences centers. Hopefully, it will include a breadth of hospitals, which expand their core missions to include teaching along with patient care. Clinical pharmacy education, itself, should concentrate on the development of core skills known to improve patient outcomes, and decrease both drug costs and total health care costs.

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APPENDIX. DEFINITION OF TERMS AND GROUPINGS USED IN THE ANALYSIS

Hospital Size
- Small: Average daily census (ADC) < 200
- Medium-size: ADC 200-399
- Large: ADC ≥400

Hospital Teaching Affiliation
- Nonteaching hospital:
  - Not associated with a college of pharmacy, school of medicine, school of nursing, allied health care program, or master of science (MS) or master of business administration (MBA) degree program
- Nonpharmacy Teaching Hospital:
  - Affiliated with a school of medicine, school of nursing, allied health care program, or MS or MBA program but not with a college of pharmacy
- Pharmacy teaching hospital:
  - Affiliated with a college of pharmacy degree program [bachelor of science (BS), MS, or doctor of pharmacy (PharmD)]

Pharmacist's Location
- Decentralized:
  - Dispensing functions supported mostly by a central pharmacy, satellite pharmacies, or mobile carts.
- Centralized:
  - Pharmacists may occasionally visit patient care units but not on a daily basis.
- Centralized with ward visit:
  - Pharmacists visit patient care units at least once daily.

Pharmacy Directors' Education
- BS: Pharmacy degree only
- MBA, PhD, nonpharmacy master's:
  - Directors with one of these degrees may also have completed a BS in pharmacy.
- MS in pharmacy:
  - Directors may also have completed a BS in pharmacy or PharmD degree.
- PharmD: Directors may also have a BS degree.

Hospital Ownership
- Government, nonfederal:
  - State, county, city-county, or hospital district or authority
- Nongovernment nonprofit: Church-operated or other
- Investor-owned (for-profit):
  - Individual, partnership, and corporation
- Government, federal:
  - Air Force, Army, Navy, Public Health Service, Veterans Administration, Public Health Service Indian Service, or Department of Justice.