ASHP national survey of pharmacy practice in hospital settings: Dispensing and administration—2008

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Purpose. Results of the 2008 ASHP national survey of pharmacy practice in hospital settings that pertain to dispensing and administration are presented.

Methods. A stratified random sample of pharmacy directors at 1310 general and children's medical–surgical hospitals in the United States were surveyed by mail.

Results. The response rate was 40.2%. Most hospitals had a centralized medication distribution system; however, there is evidence of growth in decentralized models compared with data from 2005. Automated dispensing cabinets were used by 83% of hospitals and robots by 10%. The percentage of doses dispensed in unit dose form increased, as did the use of two-pharmacist checks for high-risk drugs and high-risk patient groups. Medication administration records (MARs) have become increasingly computerized over the past nine years, and the use of handwritten MARs has declined substantially. Technology implemented at the drug administration step of the medication-use process is continuing to increase. Bar-code technology was implemented in 25% of hospitals, and 59% of hospitals had smart infusion pumps. Only 6.8% of hospitals had a pharmacist practicing in the emergency department (ED). Pharmacists prospectively reviewed only a small percentage of ED medication orders before the first dose was administered, and only 40.7% of hospitals retrospectively reviewed ED medication orders for prescribing errors. Pharmacy hours of operation have been increasing, with 36.2% of hospitals providing around-the-clock services. Off-site medication order review was used in 20.7% of hospitals. Directors of pharmacy reported a vacancy rate of 5.9% for pharmacists and 4.7% for technicians and a turnover rate of 8.6% for pharmacists and 13.8% for technicians.

Conclusion. Safe systems continue to be in place in most hospitals, but the adoption of new technology is rapidly changing the philosophy of medication distribution. Pharmacists are continuing to improve medication use at the dispensing and administration steps of the medication-use process.

Index terms: American Society of Health-System Pharmacists; Automation; Data collection; Dispensing; Drug administration; Errors, medication; Hours; Pharmaceutical services; Pharmacists, hospital; Pharmacy, institutional, hospital; Quality assurance; Technology

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The ASHP national survey of pharmacy practice in hospital settings focuses on the role that pharmacists play in managing and improving the medication-use system. The national surveys are organized according to six steps in the medication-use system: prescribing, transcribing, dispensing, administration, monitoring, and patient education. Each year, the survey focuses on two steps in the medication-use system. The 2008 survey represents the second part in the cycle and is concerned with dispensing and administration of medicines. When combined, the most recent three surveys represent a composite picture of the current role that pharmacists play in managing and improving the medication-use system.

In assessing the role of pharmacists in dispensing and administration, this study sought to describe the inpatient medication distribution system, the use of technology in medication distribution, the methods for medication preparation and

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dispensing, the process of medication administration, the use of smart infusion pumps, the use of bar-code technology, the use of medication administration records (MARs), repackaging operations, outsourcing of preparation activities, medication use in the emergency department (ED), pharmacist practice and service models, and pharmaceutical waste disposal.

This report also describes hours of operation, off-site order review, outsourcing of pharmacy operations, human resource commitments and turnover, national vacancy rates for hospital pharmacist and pharmacy technician positions, pharmacy staff training and credentials, and acquisition cost of pharmaceuticals.

Methods

The extent to which pharmacists are involved in the dispensing and administration aspects of the medication-use system was evaluated using methods similar to past ASHP surveys.[1-7]

Questionnaire development. The 2008 questionnaire was developed and pretested using procedures suggested by Dillman.[8] Questions from previous surveys that pertained to topics of interest in this survey were evaluated for clarity and response. As with past surveys, data on hospital characteristics (i.e., number of beds, U.S. Bureau of the Census region, ownership, U.S. Bureau of the Census metropolitan statistical area status,[9] medical school affiliation status) were available in the SMG Marketing Group, Inc., 2008 hospital database.[10]

Survey sample. From the SMG database of 6975 hospitals, a sampling frame of 4953 general and children's medical–surgical hospitals in the United States was constructed. Specialty, federal, and Veterans Affairs hospitals were excluded from this sampling frame. Hospitals were stratified by size before sampling, and random samples of hospitals within these strata were taken to construct the sample of 1428 hospitals. We again sampled 300 hospitals that had fewer than 50 beds to account for historically lower response rates in hospitals of this size. Unlike previous years, we sampled all hospitals with 600 or more staffed beds (n = 128) to collect data from enough of these very large hospitals to provide reliable estimates. Therefore, two categories of large hospitals were created: 400–599 staffed beds and 600 or more staffed beds. Two-hundred hospitals were sampled in each of the other hospital size categories, as was done in previous surveys (Table 1).

In March 2008, each of the 1428 hospitals was called by telephone (Reliance Teleservice, Arnold, MD) to verify the name of the pharmacy director. After eliminating closed hospitals, hospitals that no longer had pharmacies, hospitals without a permanent director of pharmacy, and pharmacies unwilling to provide the director of pharmacy's name, the adjusted sample was 1310 hospitals.

Data collection. Pharmacy directors in the sample were contacted up to six times during the survey period. An announcement letter was sent in May 2008, followed one week later by the first survey mailing. To maximize the response rate, respondents were entered into a drawing for three MP3 players as an incentive to respond to the questionnaire. Two weeks after the initial survey mailing, reminder post cards were mailed. The surveys were mailed a second time to nonrespondents in June 2008. The survey was sent a third time by United Parcel Service to remaining nonrespondents in early July 2008. A final telephone contact was attempted with nonrespondents in July 2008.

Data analysis. Each member of the sample was assigned a unique identification number. This identification number allowed the survey response to be matched with hospital characteristics in the SMG database.

As with previous surveys, data in this report are presented by categories of staffed beds to more closely align with data from the American Hospital Association.[11]

Because of the stratified random sampling procedure, it was necessary to employ a design-based analysis.[12] This technique results in population estimates that are more accurate than a method that does not account for the complex sampling design. Stratified random sampling ensured that the sample was representative of the population.

Data were entered using SPSS, version 15.0 (SPSS Inc., Chicago, IL). Data were converted to an Intercooled Stata, version 7, readable format using DBMS Copy, version 7 (Conceptual Software, Inc., Houston, TX). All non-design-based analyses were conducted using SPSS 15.0. All design-based analyses were conducted using Stata 7 using the set of survey commands. To account for oversampling the largest hospitals, weights were assigned to respondents to adjust their contribution to the population estimate. The weight was 18.54 for hospitals with fewer than 50 staffed beds, 9.56 for hospitals with 50–99 beds, 14.57 for hospitals with 100–199 beds, 8.08 for hospitals with 200–299 beds, 5.39 for hospitals with 300–399 beds, 3.87 for hospitals with 400–599 beds, and 2.17 for hospitals with 600 or more staffed beds. The strata were the categories for the number of staffed beds, and the finite population correction was the total number of hospitals in the population (4953).

Descriptive statistics were used extensively. Chi-square analysis and analysis of variance or regression was used to examine how responses differed as a function of hospital characteristics. The a priori level of significance was set at 0.05.

Results and discussion

A total of 527 usable surveys were returned for a response rate of 40.2%.

Table 1.
Size, Location, Ownership, and Affiliation of Respondents' Hospitals[a]

Characteristic	Respondents *n*	Respondents %[b]	Nonrespondents *n*	Nonrespondents %[b]	Surveyed *n*	Surveyed %[c]	Population *n*	Population %[d]
All hospitals	527	40.2	783	59.8	1310	100.0	4953	100.0
No. staffed beds								
<50	90	34.2	173	65.8	263	20.1	1669	33.7
50–99	77	42.8	103	57.2	180	13.7	736	14.9
100–199	76	40.6	111	59.4	187	14.3	1107	22.4
200–299	80	42.6	108	57.4	188	14.4	646	13.0
300–399	70	38.9	110	61.1	180	13.7	377	7.6
400–599	75	39.5	115	60.5	190	14.5	290	5.9
≥600	59	48.4	63	51.6	122	9.3	128	2.6
Region[e]								
West	88	38.9	138	61.1	226	17.3	933	19.0
Midwest	159	47.6	175	52.4	334	25.5	1428	29.2
South	187	35.3	342	64.7	529	40.4	1850	37.8
Northeast	93	42.1	128	57.9	221	16.9	687	14.0
MSA status								
Within an MSA	365	41.1	522	58.9	887	67.7	2747	55.5
Outside an MSA	162	38.3	261	61.7	423	32.3	2206	44.5
Ownership								
For profit	56	35.4	102	64.6	158	12.1	710	14.3
Nonprofit	471	40.9	681	59.1	1152	87.9	4243	85.7
Medical school affiliation								
Yes	227	43.2	299	56.8	526	40.2	1264	25.5
No	300	38.3	484	61.7	784	59.8	3689	74.5

[a]From the SMG hospital database. MSA = metropolitan statistical area.
[b]Calculated as a percentage of all hospitals surveyed in the category.
[c]Calculated as a percentage of all hospitals surveyed.
[d]Calculated as a percentage of all hospitals.
[e]$\chi^2 = 13.266$, $df = 3$, $p = 0.004$.

This response rate is substantially higher than that for most mailed questionnaires[13] and is similar to response rates of past ASHP surveys.[1-7]

Hospital characteristics. Table 1 shows the size, location, ownership, and affiliation status of the respondents' hospitals, the nonrespondents' hospitals, the surveyed hospitals, and the 4953 general and children's medical–surgical hospitals in the SMG hospital database. The characteristics of the surveyed hospitals are presented to highlight the complex sampling design used in this survey. Respondents and nonrespondents significantly differed in regional location. These differences are accounted for in the design-based analysis.

Medication distribution system. Centralized medication distribution systems include traditional manual unit dose and stationary robotic systems that automate drug dispensing using bar-code technology. Decentralized medication distribution systems include satellite pharmacies and automated dispensing cabinets. About two thirds of hospitals had a centralized inpatient pharmacy distribution system, and about one third had decentralized systems (Table 2). The use of a centralized or decentralized system is a function of hospital size. For example, 54% of hospitals with 600 or more beds had decentralized systems, whereas less than 25% of hospitals with fewer than 50 beds had decentralized distribution systems. The percentage of hospitals using the decentralized medication distribution model is increasing (19% of hospitals in 2002,[6] 26% in 2005,[3] and 33% in 2008).

Hospital pharmacy directors also provided information about future plans for the inpatient medication distribution system in their hospital. Hospital pharmacy directors were divided, with 46% envisioning a centralized system and 54% envisioning a decentralized system of medication distribution (Table 2). Hospital size appears to affect the preference for changing to a decentralized system. For example, 68% of hospitals with 200–299 staffed beds were planning for a decentralized medication distribution system, whereas only 45% of hospitals with fewer than 50 staffed beds were planning for a decentralized system. In 2002, 44% of hospital pharmacy directors envisioned a decentralized system,[6] compared with 50% in 2005[3] and 54% in 2008. These data suggest a continued shift from a

Table 2.
Current Structure and Future Direction of Pharmacy Distribution System

Characteristic	Current Structure			Future Direction		
	n	% Centralized	% Decentralized	*n*	% Centralized	% Decentralized
No. staffed beds						
<50	90	75.6	24.4	87	55.2	44.8
50–99	77	70.1	29.9	76	52.6	47.4
100–199	76	61.8	38.2	75	36.0	64.0
200–299	79	62.0	38.0	79	31.6	68.4
300–399	69	65.2	34.8	68	44.1	55.9
400–599	74	55.4	44.6	74	47.3	52.7
≥600	57	45.6	54.4	58	44.8	55.2
All hospitals—2008	522	67.2[a]	32.8	517	45.8[b]	54.2
All hospitals—2005[3]	510	73.9	26.1	510	50.1	50.0
All hospitals—2002[6]	503	80.5	19.5	503	55.9	44.1

[a]Uncorrected $\chi^2 = 13.0$, $df = 6$, design-based $F(4.2, 2156.8) = 2.8$, $p = 0.0244$.
[b]Uncorrected $\chi^2 = 17.6$, $df = 6$, design-based $F(4.2, 2144.5) = 3.7$, $p = 0.0042$.

centralized to a decentralized system for medication dispensing.

Medication distribution technology. In 2008, 10.2% of general and children's medical–surgical hospitals used a robotic distribution system that automated the dispensing of unit dose inpatient medications within their centralized distribution system (Table 3). This result is similar to the rate of 10.1% of all U.S. hospitals reported in the ASHP information technology survey.[14] Use of a robot differed significantly by hospital size, with more than 42% of the largest hospitals (600 or more staffed beds) having robots, compared with only 6% of the smallest hospitals (fewer than 50 beds). The use of robots has steadily increased. In 1999, only 4.5% of hospitals used robots for automating the unit dose system[15]; in 2002, 7.8% used robots.[6] Despite the relatively high cost of robots, the benefit of this technology appears to be influencing the rate of adoption.

Table 3.
Technology Used in Pharmacy Drug Distribution System

Characteristic	Robot		Automated Dispensing Cabinets	
	n	% Hospitals	*n*	% Hospitals
No. staffed beds				
<50	90	5.6	90	64.4
50–99	77	3.9	77	75.3
100–199	76	1.3	76	97.4
200–299	79	19.0	80	95.0
300-399	69	26.1	70	98.6
400–599	75	33.3	75	98.7
≥600	57	42.1	59	98.3
All hospitals—2008	523	10.2[a]	527	82.9[b]
All hospitals—2005[3]	510	. . .[c]	510	71.8
All hospitals—2002[6]	511	7.8	511	58.2
All hospitals—1999[15]	536	4.5	536	49.2

[a]Uncorrected $\chi^2 = 66.8$, $df = 6$, design-based $F(4.3, 2225.6) = 13.2$, $p < 0.0001$.
[b]Uncorrected $\chi^2 = 84.9$, $df = 6$, design-based $F(4.2, 2177.5) = 19.3$, $p < 0.0001$.
[c]Data collected in 2005 produced unreliable estimates.

A majority of hospitals (83%) used automated dispensing cabinets (ADCs) in their medication distribution systems (Table 3). Use of ADCs differed significantly by hospital size, with more than 98% of hospitals with 300 or more staffed beds using the devices, compared with 64% of hospitals with fewer than 50 beds. The use of ADCs has increased in the past nine years. In 1999, 49% of hospitals used ADCs,[15] compared with 58% in 2002[6] and 72% in 2005.[3]

For this survey, an ADC station was defined as one or more units accessed with a single sign-in. Stations included ADCs containing medications, i.v. solutions, and sets. The number of ADC stations averaged 20.7 and varied significantly by hospital size (Table 4). The larger the hospital, the greater the number of ADC stations. ADC stations are used throughout hospitals. The mean ± S.E. number of stations in general patient care areas, procedure areas, perioperative areas, the ED, the pharmacy, and other areas are also reported in Table 4. The number of stations differs slightly between hospitals with a centralized philosophy of drug distribution compared with a decentralized philosophy (mean ± S.E. of 18.6 ± 0.9 stations versus

Table 4.
Number of Automated Dispensing Cabinet Stations[a]

Characteristic	n	Mean ± S.E. No. Stations						
		Total	General Patient Care Areas	Procedure Areas	Perioperative Areas	Emergency Department	Inside Pharmacy	Other
No. staffed beds								
<50	54	4.7 ± 0.3	2.0 ± 0.2	0.4 ± 0.1	0.9 ± 0.1	1.1 ± 0.1	0.2 ± 0.1	0.1 ± 0.0
50–99	58	11.0 ± 1.0	5.2 ± 0.6	1.4 ± 0.2	2.2 ± 0.3	1.5 ± 0.1	0.5 ± 0.1	0.2 ± 0.1
100–199	73	17.4 ± 1.4	8.4 ± 0.8	2.7 ± 0.3	3.3 ± 0.3	2.0 ± 0.2	0.8 ± 0.1	0.3 ± 0.2
200–299	73	27.2 ± 1.8	16.1 ± 1.3	3.2 ± 0.3	4.2 ± 0.4	2.5 ± 0.2	0.9 ± 0.1	0.3 ± 0.1
300–399	63	37.3 ± 2.7	21.4 ± 2.0	4.6 ± 0.5	6.3 ± 0.8	3.7 ± 0.6	0.9 ± 0.1	0.3 ± 0.2
400–599	68	52.8 ± 3.7	29.1 ± 2.1	8.1 ± 0.9	9.3 ± 1.4	3.5 ± 0.3	1.7 ± 0.2	1.1 ± 0.5
≥600	52[b]	83.3 ± 5.7	46.7 ± 3.6	11.0 ± 1.0	11.6 ± 1.5	5.7 ± 0.5	2.4 ± 0.3	2.2 ± 1.1
All hospitals—2008	441	20.7[c] ± 0.6	11.0[d] ± 0.4	2.7[e] ± 0.1	3.5[f] ± 0.2	2.1[g] ± 0.1	0.8[h] ± 0.0	0.3[i] ± 0.1

[a] A station is one or more boxes (units) accessed with a single sign-in.
[b] $n = 50$ for the specified locations.
[c] Design-based $F(1, 434) = 504.0$, $p < 0.0001$.
[d] Design-based $F(1, 432) = 260.1$, $p < 0.0001$.
[e] Design-based $F(1, 432) = 121.7$, $p < 0.0001$.
[f] Design-based $F(1, 432) = 95.1$, $p < 0.0001$.
[g] Design-based $F(1, 432) = 13.3$, $p = 0.0003$.
[h] Design-based $F(1, 432) = 84.2$, $p < 0.0001$.
[i] Design-based $F(1, 432) = 23.7$, $p < 0.0001$.

24.1 ± 1.4 stations, respectively). This result suggests that ADCs are used extensively in hospitals, regardless of the organization of the medication distribution system.

Of those hospitals with ADCs, 87.8% had pharmacists check the accuracy and integrity of medications in the ADCs before or after medications were stocked. Further, 90.6% of hospitals had ADCs that used patient-specific medication profiles. This system limits access to medications with active orders for the specified patient after the order has been reviewed by a pharmacist. The percentage of hospitals having ADCs with patient-specific medication profiles had been increasing since 1999 (32.4% in 1999,[15] 72.4% in 2002,[6] and 88.9% in 2005[3]) but appears to have leveled off.

Manufacturers of ADCs have recognized the importance of having only the requested and correct medication available to nurses. This type of system has historically been used to limit access to controlled substances and high-cost medications. Recently, this innovation has expanded to individually secured pockets in a matrix drawer. Overall, 51.5% of hospitals used individually secured pockets as the predominant configuration in their ADCs, and 48.5% used the original matrix drawer configuration that allows access to all medications stocked in that drawer.

Of those hospitals with ADCs with patient-specific medication profiles, a mean ± S.E. of 11.8% ± 1.1% of medications was dispensed as overrides. Bypassing the patient-specific medication profiles to obtain a medication is an unsafe practice. It is encouraging that the percentage of medications dispensed as overrides has declined from 22.8% in 2002[6] and 13.3% in 2005.[3]

First- and maintenance-dose delivery. More than half of hospitals used a decentralized automated system (e.g., ADCs) as the primary method for dispensing first doses

(Table 5). Nearly 40% used a centralized manual system for first doses. Fewer used other systems as the primary method of first-dose delivery, including robots (4.8%) and satellite pharmacies (2.1%). For maintenance doses, nearly half of hospitals used a decentralized automated system, and 43% used a centralized manual system. Smaller hospitals were more likely to use centralized manual systems for dispensing first and maintenance doses than were larger hospitals. Conversely, a larger percentage of large hospitals used centralized automated systems (e.g., robots) and decentralized manual systems (e.g., satellites) to dispense first and maintenance doses compared with smaller hospitals.

The use of technology for medication fulfillment activities has resulted in a shift to decentralized automated drug delivery systems to dispense first and maintenance doses. This has changed over time, when traditional centralized manual unit dose systems of medication fulfillment for first- and maintenance-dose delivery were historically most common.[3,6,15]

Checking unit doses dispensed by pharmacy. Hospital pharmacy directors were asked the primary method used to check unit doses dispensed from their pharmacy. Overall, 82.0% of hospitals have technicians fill and pharmacists check unit doses. The next most frequent methods were having pharmacists prepare doses with no check (5.9%), having technicians prepare and check (4.9%), using robots that do not require a check (4.6%), and having technicians prepare doses with no check (1.3%).

When examining manual systems, the importance of having a system of checking unit doses dispensed from the pharmacy cannot be overemphasized. Not checking unit doses is an unsafe practice that should be minimized. More hospitals checked unit doses in 2008 than in 2005 and 2002. The use of systems that have technicians prepare and check unit

Table 5.
Primary Method of First- and Maintenance-Dose Delivery

	First-Dose Delivery					Maintenance-Dose Delivery				
Characteristic	***n***	**% Centralized Manual (e.g., Unit Dose)**	**% Decentralized Manual (e.g., Satellite)**	**% Centralized Automated (e.g., Robot)**	**% Decentralized Automated (e.g., Automated Dispensing Cabinet)**	***n***	**% Centralized Manual (e.g., Unit Dose)**	**% Decentralized Manual (e.g., Satellite)**	**% Centralized Automated (e.g., Robot)**	**% Decentralized Automated (e.g., Automated Dispensing Cabinet)**
No. staffed beds										
<50	90	56.7	2.2	1.1	40.0	90	63.3	0	1.1	35.6
50–99	77	46.8	1.3	2.6	49.4	76	47.4	0	2.6	50.0
100–199	75	29.3	0	1.3	69.3	75	37.3	0	2.7	60.0
200–299	79	29.1	0	10.1	60.8	80	26.3	0	16.3	57.5
300–399	68	20.6	2.9	14.7	61.8	70	25.7	0	20.0	54.3
400–599	74	17.6	6.8	14.9	60.8	73	13.7	0	28.8	57.5
≥600	58	8.6	20.7	17.2	53.4	59	5.1	6.8	33.9	54.2
All hospitals—2008	521	39.3[a]	2.1[a]	4.8[a]	53.8[a]	523	43.1[b]	0.1[b]	7.6[b]	49.2[b]
All hospitals—2005[3]	510	47.9	4.1	4.2	43.7	510	52.5	1.9	7.8	37.8
All hospitals—2002[6]	504	64.5	4.3	4.6	26.7	504	69.7	1.6	7.1	22.3

[a]Uncorrected $\chi^2 = 103.7$, $df = 18$, design-based $F(11.3, 5800.9) = 7.7$, $p < 0.0001$.
[b]Uncorrected $\chi^2 = 143.0$, $df = 18$, design-based $F(8.7, 4511.3) = 14.1$, $p < 0.0001$.

doses has not changed, while the use of pharmacists preparing unit doses with no check has declined.[3,6] Systems that have technicians prepare and check unit doses are as accurate as systems that use pharmacists to check unit dose carts filled by technicians.[16,17] Smaller hospitals were more likely to have pharmacists prepare unit doses with no check (uncorrected $\chi^2 = 128.2$, $df = 30$, design-based $F[13.9, 7198.6] = 7.3$, $p < 0.0001$). Pharmacists prepared unit doses with no check in 16.9% of hospitals with fewer than 50 staffed beds, compared with 1.3% of hospitals with 50–99 staffed beds and 0% of hospitals with 100 or more beds. These differences were likely due to staffing limitations in the smallest hospitals.

Table 6.
Machine-Readable Coding Used To Verify Doses Before Dispensing

Characteristic	n	% Hospitals
No. staffed beds		
<50	89	18.0
50–99	77	14.3
100–199	76	18.4
200–299	80	31.3
300–399	70	45.7
400–599	75	45.3
≥600	59	57.6
All hospitals—2008	526	24.0[a]
All hospitals—2007[1]	531	18.4
All hospitals—2006[2]	NC[b]	NC
All hospitals—2005[3]	510	11.5
All hospitals—2004[4]	492	9.2
All hospitals—2003[5]	NC	NC
All hospitals—2002[6]	511	5.7

[a]Uncorrected $\chi^2 = 38.1$, $df = 6$, design-based $F(4.2, 2197.3) = 7.9$, $p < 0.0001$.
[b]Data not collected in 2006 and 2003.

Machine-readable coding in pharmacy. Machine-readable coding increases the accuracy of medications dispensed from the pharmacy. Robots, carousel systems, and sometimes manual unit dose pick stations use machine-readable coding to verify removal and replenishment of medications. Overall, 24% of hospitals used some form of machine-readable coding to verify doses before dispensing (Table 6). The use of machine-readable coding in the pharmacy department has steadily increased from 2002, when only 5.7% of hospitals used these systems.[6]

Change in floor stock and drugs in ADCs. Pharmacy directors were asked how the numbers of drugs in traditional floor stock and ADCs have changed during the past three years. Overall, 66.4% of hospitals have decreased traditional floor stock, 21.4% have kept the amount of floor stock the same, and 12.2% have increased traditional floor stock. For drugs in ADCs, 74.3% of hospitals have increased the number of drugs, 23.2% had no change, and 2.5% have decreased the number of drugs.

Doses dispensed in unit dose form. For this survey, a unit dose was defined as a dose dispensed from the pharmacy that is ready to administer to a patient (i.e., no further dosage calculation or manipulation required). For example, warfarin sodium 2.5 mg is ordered and a package containing warfarin sodium 2.5 mg is dispensed. A unit dose package that contains warfarin sodium 5 mg with a "note strength" label for the same patient is not considered to be in unit dose form. Similarly, if gentamicin 55 mg is ordered, a syringe containing gentamicin 55 mg is considered a unit dose package but not a syringe containing gentamicin 60 mg with a "note strength" label. Also, a "majority" of orders dispensed in unit dose form was defined as 75% or more.

For noncritical care patients, 86.7% of hospitals dispensed a majority of oral medication unit doses in unit dose form. For noncritical care patients, 69.6% of hospitals dispensed a majority of injectable medications in unit dose form. For critical care patients, 69.5% of hospitals dispensed a majority of injectable medications in unit dose form. Results differed by number of staffed beds. The largest percentage of medications were dispensed in unit dose form in the largest hospitals, and these hospitals were more likely to have implemented this safe system compared with smaller hospitals. The percentage of hospitals dispensing a majority of medications in unit dose form has steadily increased during the past nine years.[3,6,15] These increases may be attributable to efforts to reduce the opportunities for errors in medication distribution and administration. The dispensing of injectable medications in unit dose form did not differ between critical care and noncritical care patients.

Point-of-care activated devices. Overall, 91.1% of hospitals used point-of-care activated small-volume parenteral products, an increase from 82% in 2002[6] and 85% in 2005.[3] Further, 95.7% of hospitals required nurses to activate the point-of-care small-volume parenteral device before administration, a rate similar to that found in 2002 and 2005.[3,6] While the potential wastage rates for returned small-volume parenterals can be decreased using these systems, these systems can be less effective if incompletely activated.[18-21]

Preparation of doses by nurses. Nurses prepared 15.7% of i.v. doses from vials or ampuls. The percentage of i.v. doses prepared by nurses differed by number of staffed beds. For example, 29.9% of i.v. doses were prepared by nurses in hospitals with fewer than 50 beds, compared with only 8% of i.v. doses prepared by nurses in hospitals with 50 or more staffed beds. While fewer pharmacy operation hours and less frequent medication use in small hospitals appear to influence the need to have nurses prepare i.v. doses, pharmacy directors should be mindful of the need to reduce opportunities for error.[19] Preparation of i.v. doses by nurses increases the opportunity for medication errors. This concern has been addressed, with a decline in the percentage of i.v. doses prepared by nurses from 19% in 2002[6] to 15% in 2005[3] and 2008. There may be additional opportunity for improvement, however.

Use of commercially available products. With the emphasis on the proper environment and technique for compounding sterile preparations, one way to decrease manipulations in the pharmacy and at the bedside is to purchase commercially available products. Commercially available small-volume parenterals include frozen, premixed, and point-of-care activated devices. Overall, 93.9% of hospitals purchased one or more small-volume parenterals whenever possible, up from 87% of hospitals in 2002.[6] In addition, 95.4% of hospitals purchased commercially available premixed large-volume parenterals whenever possible, up from 88% of hospitals in 2002.[6] The increased use of commercial products is consistent with recommendations by the *United States Pharmacopeia* and ASHP.[22-24]

Preparation of small-volume parenterals. Small-volume parenteral doses can be provided in various ways. The most common system for small-volume parenteral preparations is the minibag, used by 81.9% of hospitals (Table 7). Dispensing of vials for nurses to prepare i.v. doses was used in 10.2% of hospitals, followed by syringes to be used in syringe pumps (3.4%) and a syringe for use in a volume-control chamber or by i.v. push (0.6%). Overall, 3.9% of hospitals supplied a combination of small-volume parenterals and did not have a predominant form. The predominant form of small-volume parenteral preparations used varied by size of hospital. For example, hospitals with fewer than 50 staffed beds were the most likely to use vials prepared by nurses compared with hospitals of other sizes. It is likely that the smallest hospitals have this system in place because of pharmacy staffing limitations and limited hours of service. Nevertheless, hospitals should work toward minimizing nurse preparation of i.v. doses at the bedside to improve patient safety.

Two-pharmacist check before dispensing. Some medication therapies or patient groups are associated with higher risk than others, and pharmacists must be vigilant when dispensing these medications or to these groups. Overall, 61.2% of hospitals required a two-pharmacist check before dispensing high-risk medications (e.g., chemotherapy). In addition, 34.7% of hospitals required a two-pharmacist check before dispensing medication to high-risk groups (e.g., pediatrics). For both high-risk situations, larger hospitals were more likely to require a two-pharmacist check before dispensing. Smaller hospitals may be limited in their ability to implement such a policy, as pharmacist staffing levels may restrict the practice. Further, some hospitals may not dispense chemotherapeutic agents or serve pediatric patients. The percentage of hospitals using a two-pharmacist check for both high-risk patient groups and high-risk medications has increased from 29.9% in 2002 and 32.0% in 2005 and from 52.8% in 2002 and 56.1% in 2005, respectively,[3,6] reflecting increased pharmacist vigilance.

Table 7.
Predominant Form of Small-Volume Parenteral Dose Preparations

		% Hospitals				
Characteristic	*n*	Minibag	Syringe for Syringe Pump	Syringe for Volume-Control Chamber or i.v. Push	Vial To Be Prepared by Nurse	Other
No. staffed beds						
<50	90	72.2	0	0	22.2	5.6
50–99	77	93.5	0	2.6	2.6	1.3
100–199	74	90.5	1.4	0	2.7	5.4
200–299	80	77.5	12.5	1.3	7.5	1.3
300–399	70	85.7	7.1	0	4.3	2.9
400–599	75	84.0	9.3	0	2.7	4.0
≥600	59	76.3	13.6	1.7	6.8	1.7
All hospitals—2008	525	81.9[a]	3.4[a]	0.6[a]	10.2[a]	3.9[a]

[a]Uncorrected $\chi^2 = 93.6$, $df = 24$, design-based $F(14.1, 7289.5) = 6.7$, $p < 0.0001$.

Automation used in i.v. and total parenteral nutrition (TPN) preparation. Overall, 8.7% of hospitals used an automated syringe-filling device in a laminar-airflow hood for batch syringe compounding, and 1.1% of hospitals used a standalone robotic device for compounding flushes or syringe-based small-volume parenteral preparations. Larger hospitals were more likely to use these technologies compared with smaller hospitals. For example, nearly 5% of hospitals with 300 or more staffed beds used standalone robotic compounding devices, compared with 2.5% of hospitals with 200–299 beds and no hospitals with fewer than 200 beds (uncorrected $\chi^2 = 16.2$, $df = 6$, design-based F [3.1, 1582.0] = 9.7, $p < 0.0001$). Automated syringe-filling devices in a laminar-airflow hood were used in 28.8% of hospitals with 600 or more staffed beds, compared with 26.7% of hospitals with 400–599 beds, 17.1% of hospitals with 300–399 beds, 18.8% with 200–299 beds, 9.2% with 100–199 beds, 3.9% with 50–99 beds, and no hospitals with fewer than 50 staffed beds (uncorrected $\chi^2 = 50.8$, $df = 6$, design-based F[4.2, 2191.7] = 13.0, $p < 0.0001$). The use of these i.v. compounding technologies is at the beginning stages, and larger hospitals are most likely to use these technologies. Their use appears to depend on the volume of i.v. doses compounded and the available capital resources.

Automation is used to compound TPN preparations. Large-volume base-compounding devices were used in 31.1% of hospitals, with larger hospitals using this technology more often than smaller hospitals. The use of large-volume base-compounding devices has not changed during the past six years.[3,6] Additive-compounding devices were used in 17.4% of hospitals, an increase from 12.1% in 2002 and 14.1% in 2005.[3,6] Similar to large-volume base-compounding devices, larger hospitals were more likely to use these devices to reduce the opportunity for error when compounding TPN preparations.

Pharmacist approval of medication orders. When reviewing a medication order, a pharmacist checks for the appropriateness of the drug, dose, frequency, and route of administration; therapeutic duplication; real or potential allergies or sensitivities; real or potential interactions between the ordered medication and other medications, food, and laboratory values; other contraindications; variation from organizational criteria for use; other relevant medication-related issues or concerns; and clarification of all concerns, issues, and questions with the individual prescriber before dispensing the medication.[25] Pharmacist review of medication orders both in traditional patient care areas and in areas where medical procedures are performed can improve patient safety and quality of care. The value of pharmacist review of orders is recognized by the Joint Commission.[25] Lesar et al.[26] found that there were 3.13 errors for every 1000 orders written and 1.81 significant errors per 1000 orders in a university teaching hospital. Routine review of medication orders by a pharmacist has been recommended as a safe medication practice.[27]

Overall, 38.6% of hospitals had a formal policy requiring pharmacist review and approval of medication orders before administration of the drug to the patient in labor and delivery, 15.1% in surgery, 18.5% in radiology, 8.6% in the catheterization laboratory, 9.3% in endoscopy, and 9.3% in the ED (Table 8). Compared with 2002 and 2005, there has been an in-

Table 8.
Areas Where Pharmacists Review and Approve Medication Orders Before Medication Administration

		% Hospitals					
Characteristic	*n*	Surgery	Emergency Department	Catheterization Laboratory	Radiology	Endoscopy	Labor and Delivery
No. staffed beds							
<50	89	11.9	4.5	1.6	13.5	4.9	22.9
50–99	76	13.0	9.1	6.3	13.2	6.5	25.7
100–199	76	15.8	10.5	8.1	22.4	11.8	47.3
200–299	80	21.3	7.5	14.7	25.0	12.5	53.8
300–399	70	14.3	17.6	15.9	27.1	12.9	51.5
400–599	75	17.3	18.7	12.2	16.0	14.7	51.4
≥600	59	27.1	27.1	25.9	25.4	16.9	52.7
All hospitals—2008	525	15.1	9.3[a]	8.6[b]	18.5	9.3	38.6[c]
All hospitals—2005[3]	510	9.2	5.0	5.6	8.5	5.5	24.9
All hospitals—2002[6]	502	8.8	4.0	5.1	5.6	5.1	17.1

[a]Uncorrected $\chi^2 = 16.8$, $df = 6$, design-based $F(4.2, 2176.2) = 3.4$, $p = 0.0074$.
[b]Uncorrected $\chi^2 = 20.4$, $df = 6$, design-based $F(4.1, 1923.6) = 3.7$, $p = 0.0044$.
[c]Uncorrected $\chi^2 = 36.8$, $df = 6$, design-based $F(4.2, 2013.3) = 7.4$, $p < 0.0001$.

crease in pharmacist review of medication orders before administration to the patient in all areas, with the largest increase in labor and delivery.[3,6]

Safe medication administration practices. Many methods can be used to improve the safety of medication administration. Overall, 96.7% of hospital pharmacy directors reported regular verification of patient name by oral questioning or checking the patient's armband before medication administration. Furthermore, 91.5% reported regular double-checks of the medication order and item before administration, 90.6% reported regular removal of the unit dose medication from the package immediately before administration to the patient at the bedside, and 87.3% reported that nurses regularly witness the patient take the dose before documenting administration on the MAR.

MARs. Overall, 46.9% of hospitals used computer-generated MARs, 16.5% used handwritten MARs, and 36.6% used an electronic MAR (e-MAR) system (Table 9). Handwritten MARs were most prevalent in hospitals with fewer than 50 staffed beds, and e-MARs were most commonly used in larger hospitals. During the past nine years, the percentage of hospitals using handwritten MARs has declined from 46% to 17%.[15] Furthermore, there has been a corresponding increase in the use of computerized methods, such as computer-generated MARs and e-MARs. Handwritten MARs are unsafe because they require error-prone transcription and may contain difficult-to-read handwriting. The use of safer methods (e.g., e-MARs) will increase as hospital information systems improve and the use of electronic charting of the medication doses administered increases.

Bar-code-assisted medication administration (BCMA). The most common step in the medication-use process where errors occurred that resulted in harm to patients was prescribing (39%), followed closely by drug administration errors (38%).[28] Only 2% of drug administration errors were detected and prevented compared with the interception of 48% of prescribing errors.[28] The drug administration step is the last point in the medication-use process where a medication error can be detected and a potential adverse drug event prevented. Because of the benefits of adding an additional check to the final step in the medication-use process, the adoption of BCMA has increased during the past six years, to 25.1% in 2008 (Table 10).[3,6]

Aside from the hospitals that had BCMA, 17.6% anticipated having a BCMA system within 12 months, 32.0% planned to implement a system within one to three years, and 8.8% planned to implement a system in more than three years. Only 15% of hospitals had no plans to implement a BCMA system.

Smart infusion pumps. A smart infusion pump is a point-of-care computer that integrates the infusion pump with best practice guidelines. Smart infusion pumps have software that checks programmed doses with preset limits specific to a drug and patient care area. The clinician may either override an alert (soft alert) or not be allowed to continue at all (hard stop). Overall, 59.1% of hospitals used smart infusion pumps (Table 10). The use of smart infusion pumps varied by hospital size. Nearly 80% of hospitals with 600 or more staffed beds had smart infusion pumps, compared with about 50% of hospitals with fewer than 50 beds. The use of smart infusion pumps has increased from 32% of hospitals in 2005 to nearly 60% in 2008.[1-3] This is likely due to the replacement of aging legacy pumps that did not have software to check doses.

Medication repackaging. Overall, 31.3% of hospitals repackaged oral medications and 7.4% repackaged injectable medications, primarily for cost savings. This suggests that most hospitals are purchasing doses in available unit dose packaging rather than repackaging doses when products are commercially available. Hospitals still need to repackage medications. In fact, more than 90% of hospitals repackaged oral medications in 2005.[3] In 2008, few used repackaging as a method to contain costs.

Hospital pharmacy directors were asked what is done when medications are unavailable from manufacturers in unit dose packaging. Overall, 90.8% of hospitals repackaged bulk

Table 9.
Types of Medication Administration Records

		% Hospitals		
Characteristic	n	Handwritten	Computer Generated	Electronic
No. staffed beds				
<50	90	24.4	48.9	26.7
50–99	77	19.5	44.2	36.4
100–199	76	9.2	56.6	34.2
200–299	80	12.5	43.8	43.8
300–399	70	10.0	41.4	48.6
400–599	74	9.5	31.1	59.5
≥600	59	11.9	22.0	66.1
All hospitals—2008	526	16.5[a]	46.9[a]	36.6[a]
All hospitals—2005[3]	510	24.1	54.9	20.9
All hospitals—2002[6]	505	35.6	64.4	NC[b]
All hospitals—1999[15]	529	46.1	53.9	NC

[a]Uncorrected $\chi^2 = 35.3$, $df = 12$, design-based $F(8.4, 4351.9) = 3.8$, $p = 0.0001$.
[b]Data not collected in 1999 or 2002.

items into unit dose packaging. Conversely, 9.2% of hospital pharmacy departments sent doses that require nurses to manipulate the dose before administration to the patient. Some hospitals used "note strength" labels, others did not indicate that the dose needed manipulation, and others sent the dose with detailed instructions on how to properly manipulate the dose. The practice of sending doses that require manipulation has declined from 2002.[6] Furthermore, this practice varied significantly by hospital size; the larger the hospital, the smaller percentage of doses sent that required manipulation. For example, 4.9% of hospitals with 50 or more staffed beds sent doses that required manipulation, compared with 17.8% of hospitals with fewer than 50 staffed beds. Whenever nurses must manipulate a dose, there is an additional opportunity for error. Smaller hospitals must work to minimize the sending of doses that require manipulation. This policy directive can enhance safety in the drug administration process.

Outsourcing preparations. Overall, 41.8% of hospitals outsourced some drug preparation activities (Table 11). A greater percentage of larger hospitals outsourced some preparation activities compared with smaller hospitals (uncorrected χ^2 = 69.4, df = 6, design-based $F[4.2, 2154.9]$ = 14.7, $p < 0.0001$). For example, 77.6% of hospitals with 600 or more staffed beds outsourced some part of preparation activities, compared with 23.3% of hospitals with fewer than 50 staffed beds. The outsourcing of some preparation activities has increased from 21% of hospitals in 2002 and 31% in 2005.[3,6]

Of hospitals that outsource some part of preparation activities, approximately two thirds outsourced patient-controlled analgesia (PCA) and epidural analgesia preparations, and nearly one third outsourced some i.v. admixtures, small-volume parenteral i.v. solutions, and TPN preparations (Table 11). Less-frequently outsourced preparations included flushes (13.9%), unit dose drug repackaging (13.4%), and unit dose repackaging for bar coding (14.6%). The percentage of hospitals outsourcing PCA and epidural analgesia preparations has increased during the past six years, while the outsourcing of TPN preparations has declined.[3,6] Unit dose repackaging with bar codes is slowly increasing, corresponding to increases in the use of BCMA and central medication-dispensing robots.

Strategic practice initiatives. ***Pharmacists in the ED.*** There is increasing recognition of the complexity of medication use in the ED and the high potential for medication errors and patient harm. In many cases, the role of the pharmacist in

Table 10.
Use of Bar-Code-Assisted Medication Administration (BCMA) and Smart Infusion Pumps

Characteristic	BCMA n	BCMA % Hospitals	Smart Infusion Pumps n	Smart Infusion Pumps % Hospitals
No. staffed beds				
<50	90	20.0	90	47.8
50–99	77	24.7	76	57.9
100–199	76	27.6	76	60.5
200–299	80	27.5	79	73.4
300–399	70	25.7	70	65.7
400–599	75	37.3	75	72.0
≥600	59	32.2	59	79.7
All hospitals—2008	527	25.1	525	59.1[a]
All hospitals—2007[1]	531	19.6	531	41.1
All hospitals—2006[2]	460	13.2	460	37.0
All hospitals—2005[3]	510	9.4	510	32.2
All hospitals—2004[4]	493	4.4	NC[b]	NC
All hospitals—2003[5]	550	3.2	NC	NC
All hospitals—2002[6]	505	1.5	NC	NC

[a]Uncorrected χ^2 = 20.5, df = 6, design-based $F(4.2, 2166.1) = 4.4$, $p = 0.0012$.
[b]Data not collected before 2005.

Table 11.
Outsourcing of Medication Preparation

Outsourced Activity	% Hospitals 2008 (n = 525)	2005 (n = 510)[3]	2002 (n = 513)[6]
Any preparation activity	41.8	31.0	21.0
Specific preparation activity[a]			
Unit dose repackaging (drug only)	13.4	11.6	12.1
Unit dose repackaging (bar coding)	14.6	9.6	8.9
Total parenteral nutrient solutions	32.8	39.8	52.4
I.V. admixtures and small-volume i.v. solutions	37.3	31.4	15.7
Patient-controlled analgesia and epidural analgesia preparations	64.0	40.2	16.7
Flushes	13.9	12.8	9.1
Other	20.6	25.8	28.0

[a]Calculated from the number of hospital pharmacies that outsource any preparation activity.

the ED has been limited to stocking ADCs and retrospectively reviewing medication orders. Organizations such as the Joint Commission now require more pharmacy involvement in areas that have historically had limited oversight and involvement by pharmacists.

Overall, 6.8% of hospitals had a pharmacist regularly assigned to practice and physically present in the ED (Table 12). This varied significantly with hospital size. Larger hospitals were more likely to have a pharmacist in the ED than were smaller hospitals. For example, 54.2% of hospitals with 600 or more staffed beds had an ED pharmacist, compared with approximately 25% of hospitals with 300–599 staffed beds and less than 3% of hospitals with fewer than 300 staffed beds. Previously, it was estimated that 3.5%[3] and 3.4%[2] of hospitals had a pharmacist in the ED. Thus, the number of hospitals with an ED pharmacist has increased during the past two years.

The Joint Commission originally advocated that pharmacists prospectively review all ED medication orders.[29] This standard has been supported by the Institute of Medicine's recommendation to include clinical pharmacists on the ED care team.[30] The Joint Commission standard was initially interpreted by many as requiring a pharmacist to be physically located in the ED, but it is likely that limited resources and lack of availability of clinical ED pharmacists hampered the ability of hospitals to do this. Overall, 44.4% of hospitals did not have pharmacists prospectively review any ED orders before administration of the first dose, 1–24% of all ED medication orders were prospectively reviewed by a pharmacist in 42.3% of hospitals, 25–49% of ED medication orders were reviewed in 7.1% of hospitals, 50–74% of ED medication orders were reviewed in 2.6% of hospitals, and 75% or more of ED medication orders were reviewed in 3.7% of hospitals (Table 13). Inpatient and ED information systems are often not interfaced, presenting further challenges to pharmacist prospective review of ED orders.

The Joint Commission modified the standard to allow for a retrospective review of a sample of orders. Overall, 40.7% of hospitals retrospectively reviewed a sample of ED medication orders for prescribing errors (Table 14). The types of errors most commonly identified included wrong dose or administration rate (15.5%) and medication allergy (13.3%) (Table 14). Less-commonly identified errors included wrong drug, duplicate therapy, and drug interactions. Overall, nearly 50% of hospitals did not track ED prescribing errors or did not have data available on the most common type of ED prescribing error.

Of those hospitals without an ED pharmacist, 5.1% anticipated having an ED pharmacist within 12 months, 6.8% anticipated having an ED pharmacist in one to three years, and 2.3% in more than three years. Overall, 78.9% of hospitals had no plans to assign a pharmacist to the ED.

These data suggest that hospital pharmacy departments face challenges addressing the ASHP recom-

Table 12.
Pharmacist Regularly Assigned To Practice in Hospital Emergency Department

Characteristic	2008 *n*	2008 % Hospitals	2006[2] *n*	2006[2] % Hospitals
No. staffed beds				
<50	89	0	51	0
50–99	77	2.6	86	0
100–199	75	5.3	73	1.4
200–299	79	3.8	76	5.3
300–399	69	21.7	81	4.9
400–599	75	28.0	93[a]	23.7[a]
≥600	59	54.2		
All hospitals	523	6.8[b]	460	3.4[c]

[a]For ≥400 beds.
[b]Uncorrected $\chi^2 = 100.9$, $df = 6$, design-based $F(4.2, 2173.9) = 25.3$, $p < 0.0001$.
[c]Uncorrected $\chi^2 = 58.6854$, $df = 5$, design-based $F(2.91, 1321.84) = 21.5488$, $p < 0.0001$.

Table 13.
Emergency Department (ED) Medication Orders Prospectively Reviewed by a Pharmacist Before Administration of the First Dose

Characteristic	*n*	% ED Medication Orders 0	1–24	25–49	50–74	≥75
No. staffed beds						
<50	89	62.9	30.3	5.6	0	1.1
50–99	77	57.1	39.0	2.6	1.3	0
100–199	75	38.7	48.0	6.7	2.7	4.0
200–299	79	29.1	50.6	11.4	3.8	5.1
300–399	69	13.0	55.1	8.7	11.6	11.6
400–599	75	17.3	57.3	13.3	2.7	9.3
≥600	58	8.6	55.2	13.8	10.3	12.1
All hospitals—2008	522	44.4[a]	42.3[a]	7.1[a]	2.6[a]	3.7[a]

[a]Uncorrected $\chi^2 = 97.1$, $df = 24$, design-based $F(16.2, 8361.0) = 5.3$, $p < 0.0001$.

mendation to provide the appropriate level of pharmacy services to the ED that is necessary for safe and effective patient care.[31]

Pharmacy practice model. The pharmacy practice model describes how pharmacy department resources are deployed to provide patient care services. This includes how pharmacists practice and the services provided in the care of patients, the role of pharmacy technicians in supporting care, and the use of automation and technology in the medication-use system.

The practice model for pharmacy has been changing. Drug distribution has become more decentralized with the use of ADCs. The use of robotics in the central pharmacy to assist with i.v. dose preparation and drug distribution has also increased. Clinical training in colleges of pharmacy has increased, with all pharmacy graduates being awarded the doctor of pharmacy degree. There is also increased emphasis on pharmacy residency training. All of these trends have shaped hospital pharmacy practice models.

While there are variations in pharmacy practice models, three types were surveyed: a drug-distribution-centered model (defined as "mostly distributive pharmacy with limited clinical services"), a patient-centered integrated model (defined as "clinical generalist model with limited differentiation of roles—nearly all pharmacists have distributive and clinical responsibilities"), and a clinical-specialist-centered model (defined as "separate distributive and clinical specialist roles"). Overall, 63.5% of hospitals used a patient-centered integrated model, 25.8% used a drug-distribution-centered model, and 10.7% used a clinical-specialist-centered model (Table 15). The pharmacy practice model used varied significantly with hospital size; larger hospitals were more likely to use a clinical-specialist-centered model and least likely to have a drug-distribution-centered model, compared with smaller hospitals. For all sizes of hospitals, the patient-centered integrated model was most common. However, 40.0% of hospitals with fewer than 50 staffed beds used a drug-distribution-centered model, and 45.8% of hospitals with 600 or more staffed beds used a clinical-specialist-centered model.

Technicians perform critical activities in the pharmacy department to support the pharmacy practice model. The most common activities included restocking floor stock and ADCs (97.8%), purchasing (91.5%), billing (84.1%), compounding sterile preparations (80.4%), and filling carts (75.7%). Less common activities included managing controlled-substances (47.2%), managing information technology systems (36.8%), entering orders (33.7%), supervising other technicians (32.3%), and checking the work of other technicians (15.7%). Technicians most commonly entered orders in hospitals with less than 100 staffed beds, compounded sterile preparations in hospitals with 100 or more staffed

Table 14.
Retrospective Evaluation of Emergency Department (ED) Orders for Prescribing Errors and Common Errors Identified

Characteristic	% Hospitals
Retrospective order evaluation (n = 523)	40.7
Type of error (n = 511)	
Wrong dose or administration rate	15.7
Medication allergy	13.3
Noncompliance with institutional protocols	5.7
Wrong drug	4.2
Duplicate therapy	3.6
Drug interaction	2.9
Other	4.9
Data not available or ED prescribing errors not tracked	49.7

Table 15.
Pharmacist Deployment in Practice Model

		% Hospitals		
Characteristic	*n*	Drug-Distribution Centered[a]	Patient-Centered Integrated[b]	Clinical-Specialist Centered[c]
No. staffed beds				
<50	85	40.0	57.6	2.4
50–99	77	16.9	81.8	1.3
100–199	74	29.7	59.5	10.8
200–299	79	15.2	73.4	11.4
300–399	69	15.9	53.6	30.4
400–599	75	1.3	61.3	37.3
≥600	59	6.8	47.5	45.8
All hospitals—2008	518	25.8[d]	63.5[d]	10.7[d]

[a]Defined as "mostly distributive pharmacists with limited clinical services."
[b]Defined as "clinical generalist model with limited differentiation of roles (nearly all pharmacists have distributive and clinical responsibilities)."
[c]Defined as "separate distributive and clinical specialists roles."
[d]Uncorrected $\chi^2 = 106.3$, $df = 12$, design-based $F(8.4, 4267.4) = 11.0$, $p < 0.0001$.

beds, and managed controlled substances in hospitals with 300 or more staffed beds. As the size of the hospital increased, so did the percentage of hospitals with technicians supervising other technicians.

To keep pace with the needs of patients, the desires of personnel, and technological changes, many hospital pharmacy departments have made or are planning changes. In the past three years, about 60% of hospital pharmacy departments have made changes in the use of automation for routine dispensing, about 50% have made changes to the roles of pharmacists, and about 40% have made changes to the roles of technicians. In the next three years, about 50% of pharmacy directors planned to make changes in the use of automation for routine dispensing, about 50% planned to make changes in the roles of pharmacists, and about 40% planned to make changes in the roles of technicians. These changes, both made and planned, are not mutually exclusive (Table 16). Many hospitals have both made changes and are planning more changes. Some have neither made changes nor plan to make any changes in the use of automation, pharmacist roles, or technician roles (Table 16).

Pharmacy directors were asked which pharmacist-provided services they think are essential, and whether pharmacists provide these services at their hospital. A majority of pharmacists agreed that most of the services included in the survey were essential (Table 17). The only service not widely believed to be essential was the prospective development of a pharmaceutical care plan before orders are written (35.8%).

There are gaps between the essential services identified and the how often those services are provided. Although most of the listed services were identified as essential, many (e.g., consulting for specific therapies, attending rounds for critical care and noncritical care patients, providing educational counseling, developing pharmaceutical care plans) were not being provided in more than half of the hospitals surveyed. These gaps are opportunities for improving pharmacist services in these hospitals.

Pharmaceutical waste disposal. The public is concerned about recent reports of pharmaceuticals contaminating the water supply.[32,33] The Environmental Protection Agency Resource Conservation and Recovery Act (RCRA), the National Institute for Occupational Safety and Health (NIOSH), and state and local governments have requirements for pharmaceutical waste disposal.[34,35] Pharmacy departments are addressing the handling and disposal of pharmaceutical waste from their hospital.[36] Unfortunately, the information from these agencies is not uniform and may conflict, leading to misinterpretation and confusion in hospitals attempting to address appropriate handling and disposal of hazardous pharmaceutical waste.

Overall, 11.4% of pharmacy directors reported that they had no knowledge of RCRA requirements, 27.2% were aware of the requirements, 54.2% had basic knowledge of the requirements, and 7.3% reported that they had expert knowledge of RCRA requirements. The awareness of the RCRA has increased from 2005, when 30.9% of directors reported they were not aware of RCRA requirements.[3]

The most common reported method used by hospitals to dispose of all forms of waste (nonhazardous, chemotherapy, and NIOSH- and RCRA-listed hazardous waste) was municipal incineration or chemical treatment (Table 18). Although there are variations in state and local specific requirements for waste disposal, it is generally not recommended that waste be sent to the landfill or disposed of in a sink or toilet. Empty and partially filled nonhazardous pharmaceutical waste and trace quantities of chemotherapy can usually be sent to a municipal incinerator or chemical treatment facility. This type of trash is generally placed

Table 16.
Plans for and Changes Made in the Past Three Years to the Practice and Service Model

Changes Made or Planned	% Hospitals: Extent of Automation for Routine Dispensing[a] (*n* = 526)	Roles of Pharmacists[b] (*n* = 527)	Roles of Technicians[c] (*n* = 525)
Made significant changes in past 3 yr, no other changes planned	29.2	14.1	16.1
No or limited changes made or planned	20.0	31.5	39.0
No or limited changes made, planning significant changes in next 3 yr	19.5	20.8	22.9
Made significant changes in past 3 yr, planning significant changes in next 3 yr	31.3	33.5	22.0

[a]Uncorrected $\chi^2 = 25.0$, $df = 18$, design-based $F(12.6, 6524.4) = 1.8$, $p = 0.0424$.
[b]Uncorrected $\chi^2 = 59.8$, $df = 18$, design-based $F(12.5, 6509.9) = 4.1$, $p < 0.0001$.
[c]Uncorrected $\chi^2 = 59.8$, $df = 18$, design-based $F(12.5, 6492.8) = 1.9$, $p = 0.0242$.

Table 17.
Pharmacy Directors' Opinions on Essential Pharmacist-Provided Services and Current Status of Service

Characteristic	Agree Service Is Essential		Current Status				Gap[a]
				Currently Provide Service	Plan To Provide or Implement Service	No Current Plans To Provide or Implement Service	
	n	% Hospitals	*n*	% Hospitals	% Hospitals	% Hospitals	% Hospitals
Adjustment of medication dosage based on disease, response, or pharmacokinetic monitoring	513	97.2	523	83.7	11.4	4.9	13.5
Review of medication orders before first dose is administered	513	93.5	523	70.3	19.3	10.4	23.2
Monitoring of response to therapy through laboratory test values, progress notes, and observation	508	90.7	518	72.8	18.0	9.2	17.9
Daily patient-specific medication profile review	510	89.5	518	72.2	12.6	15.2	17.3
Medication reconciliation when patients are admitted and transferred	510	87.9	523	61.6	20.9	17.5	26.3
24/7/365 access to pharmacist and pharmacy services (inhouse or remote)	511	86.0	521	61.8	13.1	25.1	24.2
Consultation and drug therapy management for specific therapies (e.g., pain management, nutrition, anticoagulation)	512	84.2	522	49.0	32.3	18.7	35.2
Collaboration with a multidisciplinary team on drug therapy management (e.g., participation on rounds) for critical care patients	510	80.4	521	44.8	23.1	32.1	35.6
Collaboration with a multidisciplinary team on drug therapy management (e.g., participation on rounds) for noncritical care patients	510	75.4	521	37.9	22.8	39.2	37.5
Educational counseling for patients about their medicines, including discharge counseling	512	72.2	520	26.1	34.8	39.1	46.1
Prospective development of a pharmaceutical care plan before medication orders are written	508	35.8	514	5.3	16.7	78.0	30.5

[a]Gap calculated as the difference between "agree service is essential" and "currently provide service."

in green, yellow, or red containers. Concentrated chemotherapy should generally be sent to a regulated medical waste facility in black containers, as should NIOSH- or RCRA-listed waste. Although trace quantities of NIOSH- or RCRA-listed waste is not addressed in the requirements, the more conservative approach is to send these to a regulated medical waste facility. Some hospitals send all pharmaceutical waste to a regulated medical waste facility to simplify decision-making. This is a more costly approach to waste disposal. This conservative approach would be most likely to assure the facility is in compliance with requirements.

Overall, 82.8% of pharmacy directors reported that the handling of pharmaceutical waste in patient care areas was similar to handling in the pharmacy department, 10.8% did not know how pharmaceutical waste was handled, and 6.4% indicated that pharmaceutical waste was handled differently in patient care areas compared with the pharmacy department.

Appropriate handling and disposal of pharmaceutical waste can benefit hospital employees, patients, the environment, and the public. By limiting the effect of pharmaceutical waste on the environment, both public health and safety can be improved. Hospital pharmacy departments seem to be struggling with the complexities of pharmaceutical waste disposal in their communities.

Pharmacy operations. Information on pharmacy operations is useful for pharmacy managers. However, caution should be exercised when reviewing and interpreting these data. The information reported are averages. Every hospital offers unique products and services; therefore, these data should not be interpreted as established benchmarks or best practices in many cases.

Hours of operation. For all hospitals, inpatient pharmacy services were provided a mean of 106.1 hours

Table 18.
Methods of Pharmaceutical Waste Disposal

Characteristic	*n*	% Hospitals			
		Disposed of Through the Regular Trash (e.g., Landfill)	Trash Placed in Segregated, Colored Containers for Special Handling (e.g., Chemical Treatment, Municipal Incinerator)	Trash Placed in Segregated Black Containers for Incineration by Regulated Medical Waste Facility	Combination of Methods
Empty or partial-fill drug vials, unused tablets, unused i.v.'s, drug packaging, or other materials used in the preparation of nonhazardous pharmaceuticals	525	22.5	55.0	18.5	4.0
Trace quantities of chemotherapy drugs (empty drug vials, drug packaging, i.v. tubing, or other materials used in preparation)	480	9.4	71.0	18.5	1.2
Concentrated chemotherapy drug waste (partial-fill drug vials, unused i.v.'s, unused drug syringes, or unused tablets)	478	1.4	66.7	28.9	3.0
Trace quantities of drugs listed by NIOSH or EPA/RCRA[a] (empty drug vials, drug packaging, i.v. tubing, or other materials used in preparation)	523	25.4	50.3	21.0	3.3
Concentrated waste of drugs listed by NIOSH or EPA/RCRA[a] (partial-fill drug vials, unused i.v.'s, unused drug syringes, or unused tablets)	523	15.9	50.8	27.2	6.1

[a]Examples include warfarin, nitroglycerin, nicotine, select antivirals, and physostigmine. NIOSH = National Institute for Occupational Safety and Health, EPA = Environmental Protection Agency, RCRA = Resource Conservation and Recovery Act.

per week (Monday through Sunday), with smaller hospitals and health systems providing services significantly fewer hours a week than were larger hospitals. For example, in hospitals with fewer than 50 staffed beds, pharmacy departments were open 57.4 hours per week, compared with 86.1 hours in hospitals with 50–99 beds, 124.6 hours in hospitals with 100–199 beds, 150.6 hours in hospitals with 200–299 beds, and over 160 hours per week in hospitals with 300 or more staffed beds. The mean number of hours pharmacy departments were open and available to provide services increased from 101 hours in 2005[3] and 2006[2] and 103.8 hours in 2007.[1]

An estimated 36.2% of hospitals provided 24-hour inpatient pharmacy services. This also varied significantly by hospital size; the larger the hospital, the higher percentage providing 24-hour inpatient pharmacy services. For example, only 1.1% of hospitals with fewer than 50 staffed beds provided 24-hour inpatient pharmacy services, whereas 98.3% of hospitals with 600 or more staffed beds provided 24-hour inpatient pharmacy services. The percentage of hospitals providing 24-hour services has steadily increased over the past three years.[1-3]

Off-site medication order review. It has long been recognized that hospital pharmacists play a vital role in ensuring safe and effective medication use by reviewing the order before the patient receives the drug. Not all medication orders are prospectively reviewed by a pharmacist because of the limited hours of pharmacy services in some hospitals. The use of remote order technology that provides pharmacists with real-time access to the patient's medication, laboratory, and medical profile has the potential to provide access to a pharmacist 24 hours a day, seven days a week.

Of the hospital pharmacies that were not open 24 hours a day, seven days a week, 20.7% used an off-site pharmacist when the pharmacy was closed. The most frequent providers of these services were affiliated hospitals (46.5%) or a regional or national company (36.8%). The other hospitals (16.7%) using off-site pharmacist review of orders had on-call pharmacists for this activity. The use of off-site pharmacist medication order review has not changed over the past two years.[1,2]

Outsourcing pharmacy management. An estimated 6.9% of hospitals outsourced all pharmacy operations to a contract pharmacy services provider. This practice has decreased from 10.2% of hospitals in 2002[6] and 8.5% of hospitals in 2005.[3]

Product acquisition cost. Prior-year inpatient and outpatient pharmacy acquisition cost of pharmaceuticals varied significantly by hospital size (Table 19). Inpatient pharmaceutical acquisition costs included all drug products derived from blood and diagnostic agents but excluded i.v. fluids and administration sets. Outpatient pharmaceutical acquisition costs included drug products dispensed from an outpatient pharmacy and other ambulatory care settings (e.g., oncology clinics, ambulatory care surgery centers). Larger hospitals had higher inpatient and outpatient expenditures.

Staffing. The number of full-time-equivalent (FTE) pharmacists (i.e., working 40 hours per week) averaged 11.2 and varied significantly by hospital size (Table 20). The larger the hospital, the higher the number of FTE pharmacists. The number of FTE technicians was 9.9 and also varied significantly by hospital size. As with pharmacists, the larger the hospital, the higher the number of FTE technicians.

The mean number of FTE pharmacists per 100 occupied beds (average daily census) among all hospitals was 14.2 (Table 20). The mean number of FTE technicians per 100 occupied beds among all hospitals was 13.1. This varied significantly by hospital size, with the smallest hospitals having the most FTE pharmacists and technicians per 100 occupied beds.

The mean number of FTEs per 100 occupied beds for management, clinical, distributive, integrated, informatics, medication-use safety, and other pharmacists by number of staffed beds is provided in Table 21. The FTEs per 100 occupied beds for residents, pharmacy technicians, and support staff are also provided.

To compare a hospital's staffing levels to the national average, find the mean number of FTEs per 100 occupied beds in the category of staffed beds that matches an institution, multiply that number by the number of staffed beds in that hospital, and divide by 100. The allocation of FTEs across different types of pharmacist and nonpharmacist staff varied greatly by hospital size and philosophy of clinical versus distributive pharmacist designations or integrated pharmacists who spend approximately equal amounts of time in clinical and distributive activities.

Vacancies and turnover. Overall, 5.9% of FTE pharmacist positions and 4.7% of FTE pharmacy technician positions were vacant (Table 20). The percentage of vacant FTE positions was calculated by dividing the number of vacant FTE positions by the total number of FTE positions within each category of staffed bed size and overall.

The rate of inpatient pharmacy staff turnover is presented in Table 20. The overall rate of pharmacist and pharmacy technician turnover was 8.6% and 13.8%, respectively.

Staff training and credentials. Newly hired technicians must be trained about pharmacy-department-specific medication-use system policies and procedures in the hospital. Overall, 80.6% of hospitals used on-the-job training with observation, 37.1% used inhouse self-study of books or videos, 31.0% had technicians com-

Table 19.
Pharmacy Total Acquisition Cost of Pharmaceuticals in Prior Fiscal Year

Characteristic	Total Inpatient Pharmacy Acquisition Cost of Pharmaceuticals[a]			Total Outpatient Pharmacy Acquisition Cost of Pharmaceuticals[b]		
	n	Mean ± S.E. ($)	Median ($)	*n*	Mean ± S.E. ($)	Median ($)
No. staffed beds						
<50	55	761,814 ± 104,932	500,000	29	602,925 ± 127,140	341,596
50–99	59	1,892,584 ± 197,523	1,500,000	31	1,049,327 ± 223,511	587,900
100–199	51	4,183,012 ± 483,188	3,600,000	31	2,335,650 ± 355,996	1,560,000
200–299	60	6,572,654 ± 418,087	6,000,000	42	2,802,604 ± 470,557	1,882,486
300–399	62	9,794,370 ± 674,320	8,396,650	41	5,522,468 ± 949,004	3,000,000
400–599	62	16,683,891 ± 1,351,780	15,292,740	52	10,224,276 ± 1,345,204	6,000,000
≥600	53	26,705,883 ± 1,218,692	25,534,050	42	15,312,844 ± 1,943,197	8,000,000
All hospitals—2008	402	5,279,337[c] ± 173,585	NC[d]	268	3,419,795[e] ± 213,742	NC
All hospitals—2007[1]	431	4,955,941 ± 230,759	NC	236	3,682,685 ± 402,024	NC
All hospitals—2006[2]	417	4,897,533 ± 224,484	NC	NC	NC	NC
All hospitals—2005[3]	461	5,225,972 ± 227,695	NC	NC	NC	NC
All hospitals—2004[4]	450	4,654,746 ± 181,331	NC	NC	NC	NC
All hospitals—2003[5]	499	4,308,021 ± 98,601	NC	NC	NC	NC
All hospitals—2002[6]	446	3,848,311 ± 140,959	NC	NC	NC	NC

[a]Defined as "total acquisition cost (i.e., total purchases) for all pharmaceuticals, including drug products derived from blood and diagnostic agents but excluding i.v. fluids and i.v. administration sets."
[b]Defined as "total acquisition cost (i.e., total purchases) for all pharmaceuticals, including drug products dispensed from an outpatient dispensing pharmacy and other ambulatory care settings (e.g., oncology clinics, ambulatory surgery centers)." Applies only to hospitals with outpatient operations.
[c]Design-based $F(1, 395) = 111.02$, $p < 0.0001$.
[d]Data not computed or not collected.
[e]Design-based $F(1, 261) = 210.59$, $p < 0.0001$.

plete a structured external training program, and 16.6% used inhouse didactic training (lecture with written components). Furthermore, 25.6% of hospitals required technicians to be certified by the Pharmacy Technician Certification Board (PTCB), and 33.4% of hospitals had a timeframe during which technicians must become PTCB certified if they were not already certified before being hired. Overall, 58.4% of hospital pharmacy technicians were PTCB certified.

For pharmacists, 13.8% of current staff had completed a postgraduate year 1 pharmacy practice residency, 3.5% had completed a specialty residency, and 6.4% were certified by the Board of Pharmaceutical Specialties. These credentials and experiences provide evidence of the specialized knowledge and experiences needed within the pharmacy work force to improve medication use and advance patient care in hospitals.

Summary and conclusion

The primary role of pharmacists is to ensure safe medication use. Medication dispensing and distribution practices affect safe medication administration. Results of this survey demonstrate encouraging trends in safe medication use in U.S. hospitals.

Medication dispensing and preparation systems are becoming safer. The medication distribution system, while still predominantly a centralized system, has become more decentralized during the past six years. The use of ADCs has facilitated this transition. Hospitals are placing medicines closer to patients. Nearly 83% of hospitals now use ADCs as part of their drug distribution system. More than half of hospitals use individually secured pockets as the primary ADC configuration, and more than 90% use ADCs with patient-specific medication profiles. Limiting nurses' access to only the requested medication after the order has been reviewed by a pharmacist

Table 20.
Inpatient Pharmacy Staffing in Prior Fiscal Year

Characteristic	*n*	Mean ± S.E. FTE Pharmacists[a]	Mean ± S.E. FTE Pharmacists per 100 Occupied Beds	% Vacant FTE Pharmacist Positions[b]	% Pharmacist Turnover[c]	Mean ± S.E. FTE Pharmacy Technicians	Mean ± S.E. FTE Pharmacy Technicians per 100 Occupied Beds	% Vacant FTE Pharmacy Technician Positions[b]	% Pharmacy Technician Turnover[b]
No. staffed beds									
<50	88	2.4 ± 0.5	19.9 ± 2.6	7.0	10.8	1.8 ± 0.2	18.2 ± 2.2	6.4	12.0
50–99	76	4.6 ± 0.4	13.9 ± 1.9	7.5	12.3	4.5 ± 0.4	14.4 ± 2.5	5.3	9.7
100–199	75	10.2 ± 0.9	11.3 ± 0.9	5.7	9.2	8.8 ± 0.5	10.6 ± 0.6	2.1	13.7
200–299	79	15.4 ± 1.0	9.8 ± 0.9	5.9	8.1	13.6 ± 0.9	8.5 ± 0.7	4.3	13.8
300–399	70	21.3 ± 1.1	8.8 ± 0.4	5.1	8.7	19.2 ± 0.9	8.0 ± 0.3	4.3	13.9
400–599	73	38.0 ± 2.6	10.6 ± 0.6	6.4	8.1	31.7 ± 2.0	8.8 ± 0.4	5.5	16.1
≥600	59	61.9 ± 2.8	10.2 ± 0.4	5.5	6.5	57.8 ± 3.7	9.4 ± 0.6	7.6	13.2
All hospitals—2008	520	11.2[d] ± 0.3	14.2[e] ± 1.0	5.9	8.6	9.9[f] ± 0.2	13.1[g] ± 0.9	4.7	13.8

[a]FTE = full-time-equivalent.
[b]Calculated as number of vacant FTE positions / total FTE positions.
[c]Calculated as number of FTE resignations / total FTE positions.
[d]Design-based $F(1, 513) = 237.80$, $p < 0.0001$.
[e]Design-based $F(1, 496) = 16.67$, $p = 0.0001$.
[f]Design-based $F(1, 509) = 153.67$, $p < 0.0001$.
[g]Design-based $F(1, 492) = 10.10$, $p = 0.0016$.

is a safe practice. The percentage of doses accessed from ADCs without this review has declined from 22% in 2002 to less than 12% in 2008. These findings suggest a safer use of point-of-care automation.

The use of automation has also increased in the central pharmacy. Robots were used by 10% of hospitals, and machine-readable coding was used in 24% of hospitals to verify doses before dispensing. Over the past three years, two thirds of hospitals have decreased traditional floor stock, and pharmacies are dispensing more doses in a ready-to-administer unit dose form for both oral and injectable medications. Over the past six years, the use of commercially available small-volume parenterals (premixed and point-of-care activated systems) has increased, as has the outsourcing of preparation activities. The number of injectable doses that must be prepared at the bedside by nurses is decreasing, and pharmacy departments have increased the use of a double-check system for high-risk drugs and patient groups. These trends suggest a commitment of resources and a determination to use proven medication-use systems to reduce errors.

Medication administration is also becoming safer. MARs have become increasingly computerized over the past nine years, primarily with the introduction of e-MARs. The use of handwritten MARs has declined substantially. Technology used at the administration step of the medication-use process is continuing to increase. BCMA technology has been implemented in 25% of hospitals, a substantial increase from 1.5% of hospitals in 2002. To administer i.v. medications, 59% of hospitals use smart infusion pumps that verify programmed doses against established institutional guidelines. These technologies contribute to reducing the risk of errors at the most vulnerable point of medication use: the administration step.

Table 21.
Pharmacy FTEs per 100 Occupied Beds by Type of Position[a]

Characteristic	*n*	Mean FTEs per 100 Occupied Beds										
		Management Pharmacist	Clinical Pharmacist	Distributive Pharmacist	Integrated Pharmacist	Informatics Pharmacist	Medication-Use Safety Coordinator Pharmacist	Other Pharmacist	Resident	Total Pharmacists	Total Pharmacy Technicians	Total Other Support Staff
No. staffed beds												
<50	87	4.80	0.97	3.23	10.61	0.18	0.13	0.03	0	19.9	18.2	0.92
50–99	75	2.44	1.08	2.81	6.10	0.09	0.04	0.02	0.77	13.9	14.4	0.34
100–199	75	1.63	1.31	3.27	4.74	0.20	0.08	0.03	0.08	11.3	10.6	0.45
200–299	79	1.12	0.94	2.25	4.88	0.20	0.06	0.08	0.17	9.8	8.5	0.70
300–399	69	0.99	1.38	2.74	3.09	0.23	0.07	0.09	0.24	8.8	8.0	1.05
400–599	73	1.26	1.61	3.15	3.25	0.22	0.13	0.37	0.64	10.6	8.8	0.91
≥600	58	0.93	1.85	2.63	3.66	0.19	0.09	0.22	0.79	10.2	9.4	0.89
All hospitals—2008	516	2.67[b]	1.15	2.99	6.71[c]	0.18	0.09	0.07[d]	0.23	14.2[e]	13.1[f]	0.71

[a]Standard errors are available on request from the authors of the study. FTE = full-time-equivalent.
[b]Design-based $F(1, 493) = 89.76$, $p < 0.0001$.
[c]Design-based $F(1, 497) = 13.80$, $p = 0.0002$.
[d]Design-based $F(1, 509) = 5.40$, $p = 0.0206$.
[e]Design-based $F(1, 496) = 16.67$, $p = 0.0001$.
[f]Design-based $F(1, 492) = 10.10$, $p = 0.0016$.

The prevalence of safe medication-use practices in procedure areas is low. However, pharmacists are reviewing more medication orders in these areas of the hospital. The use of pharmacists in the ED is currently limited to only 6.8% of hospitals. There has been limited but slow growth of this practice during the past two years, increasing from 3.4% of hospitals in 2006. In December 2008, ASHP published a statement recommending that the pharmacy department provide the ED with the pharmacy services necessary for safe and effective patient care.[31] The methods used to ensure appropriate medication use in the ED vary for each institution but may include (1) working with the ED team to monitor medication-use systems, especially for high-risk patients and procedures, (2) promoting evidence-based medication use, (3) participating in the selection, implementation, and monitoring of medication-use technologies, (4) providing direct patient care in collaboration with the ED team, (5) participating in emergency-preparedness efforts and quality-improvement initiatives, (6) educating patients, caregivers, and health care professionals about safe medication use, and (7) facilitating ED-based research. Many of these activities are at a policy, not at a direct patient care, level. Nevertheless, appropriate medication selection and use at the time of care delivery are critical for successful patient outcomes. Prospective pharmacist review of medication orders is an important part of any well-designed medication-use system. The review of ED medications orders can be conducted by a pharmacist physically located in the ED or remotely in the central pharmacy. Currently, only a small percentage of ED medication orders are prospectively reviewed by a pharmacist. Moreover, only 40% of hospitals retrospectively review ED medication orders. To best contribute to safe medication use in the ED, pharmacists must continue to close the gap between current practices and those known to improve medication use.

The majority (63.5%) of hospitals use a patient-centered integrated (clinical generalist) pharmacy practice model. Clinical specialist models are used primarily in the largest hospitals, and a drug-distribution-centered model is most common in the smallest hospitals. Many hospital pharmacy departments have made changes to their use of automation, pharmacist roles, and technician roles. These practice model changes are in response to demand for changes in input and output. Many hospitals have changes planned for their use of automation, pharmacist roles, and technician roles. Many of these changes may address gaps that exist between identified essential pharmacist-provided services and the current state in hospitals.

The 2008 ASHP survey results indicate that pharmacists are continuing to improve medication use at the dispensing and administration steps of the medication-use system.

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