ASHP national survey of pharmacy practice in hospital settings: Monitoring and patient education—2009

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Purpose. Results of the 2009 ASHP national survey of pharmacy practice in hospital settings that pertain to monitoring and patient education are presented.

Methods. A stratified random sample of pharmacy directors at 1364 general and children's medical–surgical hospitals in the United States were surveyed by mail. SDI Health supplied data on hospital characteristics; the survey sample was drawn from SDI's hospital database.

Results. The response rate was 40.5%. Virtually all hospitals (97.3%) had pharmacists regularly monitor medication therapy in some capacity; nearly half monitored 75% or more of their patients. Over 92% had pharmacists routinely monitor serum medication concentrations or their surrogate markers, and most hospitals allowed pharmacists to order initial serum concentrations (80.1%) and adjust dosages (79.2%). Interdisciplinary committees reviewed adverse drug events in 89.3% of hospitals. Prospective analysis was conducted by 66.2% of hospitals, and retrospective analysis was performed by 73.6%. An assessment of safety culture had been conducted by 62.8% of hospitals. Most hospitals assigned oversight for patient medication education to nursing (89.0%), but many hospitals (68.9%) reported that pharmacists provided medication education to 1–25% of patients. Computerized prescriber-order-entry systems with clinical decision support were in place in 15.4%, bar-code-assisted medication administration systems were used by 27.9%, smart infusion pumps were used in 56.2%, and complete electronic medical record systems were in place in 8.8% of hospitals. The majority of hospitals (64.7%) used an integrated pharmacy practice model using clinical generalists.

Conclusion. Pharmacists were significantly involved in monitoring medication therapy. Pharmacists were less involved in medication education activities. Technologies to improve the use of medications were used in an increasing percentage of hospitals. Hospital pharmacy practice was increasingly integrated, with pharmacists having both distribution and clinical roles.

Index terms: American Society of Health-System Pharmacists; Computers; Data collection; Drug use; Medication orders; Patient education; 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 aspects in the medication-use system: prescribing, transcribing, dispensing, administration, monitoring, and patient education. Each year, the survey focuses on two aspects in the medication-use system. The 2009 survey represents the third part in this cycle and addresses monitoring and patient education. When combined, the most recent three surveys represent a composite picture of the current role of pharmacists in managing and improving the entire medication-use system.

In assessing the role of pharmacists in patient monitoring and education, the present study sought to describe and characterize the trends in pharmacists' therapeutic drug monitoring activities, describe the methods used to monitor adverse drug events

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(ADEs), characterize external ADE reporting, and identify patient education and counseling activities.

This study also describes the assignment of pharmacists to patient care areas, pharmacists' participation on code teams, the status of medication reconciliation, the implementation of medication-use-system technologies, changes in the pharmacy practice model, the implementation of standardized i.v. concentrations, restricted drug distribution programs, and the accreditation status of hospitals.

Pharmacy operation data presented include hours of operation, square footage allocations, human resource commitments and turnover, estimates of national vacancy rates for hospital pharmacist and pharmacy technician positions, annual inventory turnover, and the acquisition cost of pharmaceuticals.

Methods

The extent to which pharmacists are involved in the monitoring and patient education aspects of the medication-use system was evaluated using methods similar to those of past ASHP surveys.[1-8]

Questionnaire development. The 2009 questionnaire was developed and pretested by using procedures suggested by Dillman.[9] 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,[10] medical school affiliation status) were available in the SDI Health hospital database.[11] Therefore, we used the available data rather than gather these data.

Survey sample. From the SDI database of 6975 hospitals, a sampling frame of 4898 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 select the sample of 1428 hospitals. We sampled 300 hospitals with fewer than 50 beds to account for historically lower response rates in hospitals of this size. 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. Two hundred hospitals were sampled in each of the other hospital-size categories, as was done in previous surveys.

In April 2009, each of the 1428 hospitals was called (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 name of the director of pharmacy, the adjusted sample consisted of 1364 hospitals.

Data collection. Pharmacy directors in the sample were contacted up to a total of six times during the survey period. An announcement letter was mailed in May 2009; this was followed one week later by the first survey mailing. To increase the response rate, all respondents were entered into a drawing for three MP3 players as an incentive to respond to the questionnaire. Respondents were offered a choice of completing a paper survey or an online survey (Qualtrics, Provo, UT). Two weeks after the initial survey mailing, reminder postcards were mailed. The surveys were mailed a second time to nonrespondents in June. The survey was sent a third time by the United Parcel Service to the remaining nonrespondents in July. A final telephone contact was attempted with nonrespondents in July.

Data analysis. Each hospital in the sample was assigned a unique identification number. This number allowed the survey response to be matched with the hospital characteristics in the SDI database. As with past surveys, data in this report are presented by categories of staffed beds to more closely align with the data presented by the American Hospital Association.[12]

Because of the stratified random sampling procedure, it was necessary to use a design-based analysis.[13] This technique produces population estimates that are more accurate than a method not accounting for the complex sampling design. Stratified random sampling also ensured that the sample was representative of the population.

Data were entered using SPSS version 16.0 (SPSS Inc., Chicago, IL). Data were converted to an Intercooled Stata version 8 readable format (Stata Corp., College Station, TX) using DBMS Copy version 7 (Conceptual Software, Houston, TX). All nondesign-based analyses were conducted using SPSS version 16. All design-based analyses were conducted using Stata version 8. To account for the sampling method, weights were assigned to respondents to adjust their contribution to the population estimate. The weight was 19.55 for hospitals with fewer than 50 staffed beds, 10.11 for hospitals with 50–99 beds, 14.79 for hospitals with 100–199 beds, 6.85 for hospitals with 200–299 beds, 4.57 for hospitals with 300–399 beds, 3.35 for hospitals with 400–599 beds, and 2.06 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 (4898).

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 553 hospitals submitted usable data for analysis. Of these, 377 surveys (68.2%) were returned by mail, and 176 responses (31.8%) were submitted online. The overall response rate was 40.5%. This response rate is substantially higher than that for most mailed or online questionnaires[9] and is similar to the response rate for recent national surveys.[1-5]

Hospital characteristics. Table 1 shows the size, location, ownership, and affiliation status of the respondents' hospitals, the nonrespondents' hospitals, the surveyed hospitals, and the 4898 general and children's medical–surgical hospitals. The characteristics of the surveyed hospitals are presented to highlight the complex sampling design used in this survey. Respondents and nonrespondents statistically differed in regional location, but these differences are accounted for in the design-based analysis.

Medication therapy monitoring. In virtually all hospitals (97.3%), pharmacists regularly monitored medication therapy for patients. In those facilities where patients were regularly monitored, 44.6% of hospitals had distributive pharmacists regularly perform this function, 44.6% used clinical pharmacists, 65.2% used integrated clinical–distributive pharmacists, 13.5% used pharmacy residents, and 38.3% used student pharmacists. Pharmacists in larger hospitals performed medication therapy monitoring activities more frequently ($p < 0.05$). In 2000, 49.2% of hospitals had distributive pharmacists monitor medication therapy, 40.6% used clinical pharmacists, 51.3% used integrated pharmacists, 9.4% used pharmacy residents, and 24.5% used student pharmacists. The use of distributive pharmacists to monitor medication therapy has declined and the use of other pharmacists to monitor medication therapy has steadily increased over the past nine years.[3,6,14]

Approximately one sixth of hospitals had pharmacists monitoring less than 26% of patients (Table 2). Nearly one quarter of hospitals had pharmacists monitor 26–50% of

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

Characteristic	Respondents		Nonrespondents		Surveyed		Population	
	n	%[b]	*n*	%[b]	*n*	%[c]	*n*	%[c]
All hospitals	553	40.5	811	59.5	1364	100	4898	100
No. staffed beds[d]								
<50	85	30.4	195	69.6	280	20.5	1662	33.9
50–99	72	39.3	111	60.7	183	13.4	728	14.9
100–199	73	38.2	118	61.8	191	14.0	1080	22.0
200–299	93	46.5	107	53.5	200	14.7	637	13.0
300–399	82	42.7	110	57.3	192	14.1	375	7.7
400–599	86	44.6	107	55.4	193	14.1	288	5.9
≥600	62	49.6	63	50.4	125	9.2	128	2.6
Region								
West	109	41.9	151	58.1	260	19.1	933	19.0
Midwest	169	44.7	209	55.3	378	27.7	1428	29.2
South	181	36.9	309	63.1	490	35.9	1850	37.8
Northeast	94	39.8	142	60.2	236	17.3	687	14.0
MSA status[e]								
Within an MSA	401	42.8	536	57.2	937	68.7	2698	55.1
Outside an MSA	152	35.6	275	64.4	427	31.3	2200	44.9
Ownership[f]								
For-profit	52	32.9	106	67.1	158	11.6	683	13.9
Nonprofit	501	41.5	705	58.5	1206	88.4	4215	86.1
Medical school affiliation								
Yes	245	43.4	320	56.6	565	41.4	1251	25.5
No	308	38.5	491	61.5	799	58.6	3647	74.5

[a]From the SDI hospital database. MSA = metropolitan statistical area.
[b]For row.
[c]For column.
[d]$\chi^2 = 21.451$, $df = 6$, $p = 0.002$.
[e]$\chi^2 = 6.306$, $df = 6$, $p = 0.012$.
[f]$\chi^2 = 4.317$, $df = 6$, $p = 0.038$.

patients, about one fifth of hospitals had pharmacists monitor 51–75% of patients, and nearly one half of hospitals had pharmacists monitor 75% or more of patients. The percentage of patients whose medication therapy was monitored by pharmacists has increased from 2000, 2003, and 2006, when 43.3%, 30.7%, and 22.1% of hospitals, respectively, had pharmacists monitor less than 26% of patients.[3,6,14]

Table 2.
Percentage of Patients Monitored by Pharmacists

Year	n	% Patients Monitored by Pharmacists			
		<26	26–50	51–75	>75
All hospitals—2009	537	16.7	23.1	18.6	42.6
All hospitals—2006[3]	448	22.1	34.2	19.4	24.4
All hospitals—2003[6]	534	30.7	26.5	19.8	23.0
All hospitals—2000[14]	517	43.3	19.3	17.0	20.3

Methods to identify patients in need of monitoring. There are many ways to identify the patients most likely to benefit from medication therapy monitoring. Most hospitals (74.5%) used a list of medications to identify patients who required daily monitoring by pharmacists. This varied significantly with staffed-bed size; larger hospitals were most likely to identify specific medications (uncorrected $\chi^2 = 58.5734$, $df = 6$, design-based $F(3.91, 2096.58) = 12.4481$, $p < 0.0001$). For example, 88.5% of hospitals with 600 or more staffed beds used a list of medications, whereas only 55.0% of hospitals with fewer than 50 beds used such a list. The use of a formalized list of medications to identify patients for medication therapy monitoring has increased over the past nine years, from 54.1% of hospitals in 2000, 58.4% in 2003, and 62.8% in 2006.[3,6,14]

Furthermore, 76.6% of hospitals identified patients for monitoring by using abnormal laboratory values that prompt dosage adjustments. This varied significantly based on staffed-bed size; larger hospitals were most likely to use abnormal laboratory values (uncorrected $\chi^2 = 27.0918$, $df = 6$, design-based $F(3.93, 2104.91) = 5.6946$, $p = 0.0002$). For example, 88.5% of hospitals with 600 or more staffed beds used this method, whereas only 63.8% of hospitals with fewer than 50 beds used abnormal laboratory values as a trigger for monitoring. The use of abnormal laboratory values that prompt dosage adjustment as a method to identify patients for medication therapy monitoring has increased from 2006, when 72.5% of hospitals reported using this method.[3]

Only 39.5% of hospitals identified patients for monitoring by specific medical or surgical services. This varied significantly with staffed-bed size; larger hospitals were most likely to identify patients by specific medical or surgical services (uncorrected $\chi^2 = 136.3385$, $df = 6$, design-based $F(3.85, 2064.56) = 27.5416$, $p < 0.0001$). For example, 83.6% of hospitals with 600 or more staffed beds identified patients by specific medical or surgical services, compared with 78.6% of hospitals with 400–599 beds, 79.3% of hospitals with 300–399 beds, 63.0% of hospitals with 200–299 beds, 45.2% of hospitals with 100–199 beds, 16.9% of hospitals with 50–99 beds, and 16.2% of hospitals with fewer than 50 staffed beds. The percentage of hospitals using specific medical or surgical services to identify patients for medication therapy monitoring was lower than in 2000 (47.8% of hospitals) and 2003 (48.3% of hospitals) but higher than in 2006 (38.0%).[3,6,14] However, the use of this method has remained stable over the past three years.

In 2006, 58.7% of hospitals used an informal process to identify patients for daily pharmacist monitoring, compared with 40.3% of hospitals in 2009.[3] Other mechanisms used to identify patients in need of monitoring included hospital committee directives (47.3%), high-cost medications (31.3%), and selected diseases (29.9%). These mechanisms have remained stable over the past three years.[3,6,14] Larger hospitals were more likely to use committee directives, selected diseases, and high-cost therapies to identify patients, and smaller hospitals were more likely to use an informal process ($p < 0.05$). Overall, the identification of patients for monitoring is becoming more structured.

Access to electronic information. Computer access to laboratory data was readily available to pharmacists to monitor medication therapy in 92.7% of hospitals (Table 3). This varied significantly with staffed-bed size; larger hospitals were most likely to have computer-accessible laboratory data available to pharmacists. Overall, 88.8% of hospitals provided pharmacists access to laboratory data through their enterprise information system or had the laboratory system interfaced with the pharmacy computer system, 20.6% had the laboratory system available from a computer terminal in the pharmacy using a separate secured access, and 12.4% provided pharmacists access to the laboratory system through a computer terminal in patient care areas. Access by pharmacists to laboratory data using electronic systems has greatly increased during the past nine years.[3,6,14]

Activities implemented to improve monitoring. Various methods have been implemented during the past three years to promote medication therapy monitoring by pharmacists. Common activities included

Table 3.
Electronic Access to Laboratory Data by Pharmacists

Characteristic	n	% Respondents
No. staffed beds		
<50	85	80.0
50–99	72	98.6
100–199	73	98.6
200–299	93	100
300–399	82	100
400–599	85	100
≥600	62	100
All hospitals—2009	552	92.7[a]
All hospitals—2006[3]	460	87.3
All hospitals—2003[6]	552	78.0
All hospitals—2000[14]	523	73.8

[a]Uncorrected $\chi^2 = 67.8955$, $df = 6$, design-based $F(2.86, 1559.28) = 15.4702$, $p < 0.0001$.

promoting the value of clinical pharmacy services (56.4%), increasing access to patient-specific data (44.3%), and expanding pharmacy technician responsibilities (35.4%) (Table 4). Less-frequently reported methods included implementing an automated dispensing system (29.9%), increased hiring of clinical pharmacy staff (29.2%), redeploying pharmacists to patient care units (23.5%), implementing computerized prescriber order entry (CPOE) (16.2%), decentralizing pharmacist order entry (14.7%), and implementing satellite pharmacies (5.6%). Ten percent of hospitals had not implemented any of these methods to improve pharmacists' involvement in medication monitoring over the past three years.

Strategies used to improve monitoring varied significantly with staffed-bed size; larger hospitals were most likely to have promoted the value of clinical pharmacy, increased hiring of clinical pharmacy staff, redeployed pharmacists to patient care units, implemented CPOE, decentralized pharmacist order entry, and implemented satellite pharmacies. Smaller hospitals were most likely not to have employed any of these strategies during the past three years.

These data suggest that larger hospitals may be better able to make the changes needed to increase the roles of pharmacists in medication therapy monitoring than are smaller hospitals. However, small hospitals were equally likely to have increased access to patient-specific data, expanded pharmacy technician responsibilities, and implemented an automated dispensing system to increase medication therapy monitoring by pharmacists.

Therapeutic drug monitoring. More than 92% of hospitals had pharmacists routinely monitor serum medication concentrations or their surrogate markers (Table 5). In 80.1% of these hospitals, pharmacists had the authority, by protocol, to order an initial serum medication concentration, and 79.2% allowed pharmacists to adjust the dosage of a medication being monitored. Furthermore, in 37.9% of hospitals, pharmacists were routinely notified when medication concentrations fell outside of the therapeutic range. During the past nine years, therapeutic drug monitoring by pharmacists and their authority to order a laboratory result for serum medication concentrations and to adjust dosages have increased.[3,6,14]

Pharmacists routinely documented their medication therapy monitoring activities in 85.3% of hospitals. This documentation increased from 76.7% of hospitals in 2003 and 81.3% in 2006.[3,6] Pharmacists most frequently documented medication therapy monitoring activities in the pharmacy patient profile (73.3%) and in the patient medical record (65.0%). Documentation in the medication administration record was infrequent (7.2%). Pharmacist documentation in the patient medical record increased from 57.4% of hospitals in 2003 and 63.5% in 2006.[3,6] Furthermore, 40.3% of hospitals had a systematic and well-documented method for evaluating the quality of the clinical monitoring services provided by pharmacists.

Genetic testing. Testing for gene variants that affect drug or dosage selection has great promise for individualizing patient drug therapy. Only 2.7% of hospitals performed testing for gene variants for dosage or drug selection, and 88.9% of hospitals did not; the status was unknown at 8.4% of hospitals. Pharmacy directors at larger hospitals were more likely to report the use of genetic testing and that the status was unknown ($p < 0.05$). Among respondents who did use genetic tests, 85.2% indicated that pharmacists had access to the genetic test results.

ADE monitoring and reporting. Because operational definitions for ADEs vary, hospital pharmacy directors were provided the following definition of ADEs: "An adverse drug event is an injury resulting from the use of, or not using, a needed medication. For the purposes of this survey, consider adverse drug events to include both adverse drug reactions and medication errors, including both errors of commission and omission that result in adverse clinical outcomes."[15]

Methods to identify ADEs. Hospital pharmacy directors were asked which methods pharmacists used to routinely monitor patients for ADEs. The most common methods were notifi-

Table 4.
Activities Implemented Over Last Three Years to Promote Medication Therapy Monitoring by Pharmacists

Characteristic	*n*	% Respondents: Promoted Value of Clinical Pharmacy Services	Increased Access to Patient-Specific Data	Expanded Pharmacy Technician Responsibilities	Implemented an Automated Dispensing System	Increased Hiring of Clinical Pharmacy Staff	Redeployed Pharmacists to Patient Care Units	Implemented Computerized Prescriber Order Entry	Decentralized Pharmacist Order Entry	Implemented Satellite Pharmacies	None of These Activities
No. staffed beds											
<50	85	37.6	45.9	32.9	36.5	10.6	5.9	10.6	4.7	1.2	18.8
50–99	71	54.9	46.5	33.8	25.4	23.9	18.3	9.9	7.0	0	12.7
100–199	73	61.6	41.1	35.6	26.0	37.0	35.6	20.5	23.3	9.6	4.1
200–299	93	76.3	46.2	34.4	23.7	34.4	30.1	12.9	19.4	5.4	6.5
300–399	81	72.8	40.7	43.2	33.3	51.9	44.4	32.1	23.5	14.8	2.5
400–599	85	76.5	41.2	43.5	27.1	62.4	42.4	22.4	30.6	12.9	2.4
≥600	62	71.0	46.8	40.3	29.0	71.0	43.5	43.5	30.7	19.4	0
All hospitals—2009	550	56.4[a]	44.3	35.4	29.9	29.2[b]	23.5[c]	16.2[d]	14.7[e]	5.6[f]	10.4[g]
All hospitals—2006[3]	460	24.1	45.0	46.0	39.2	31.9	23.7	7.0	17.1	5.8	16.0
All hospitals—2003[6]	545	22.7	39.9	51.9	38.4	28.7	23.9	6.5	15.7	4.9	14.1
All hospitals—2000[14]	519	44.5	37.6	53.2	29.5	24.1	26.0	5.2	15.8	7.9	15.0

[a]Uncorrected $\chi^2 = 50.9124$, $df = 6$, design-based $F(3.90, 2116.32) = 10.6271$, $p < 0.0001$.
[b]Uncorrected $\chi^2 = 76.5091$, $df = 6$, design-based $F(3.86, 2096.54) = 15.2179$, $p < 0.0001$.
[c]Uncorrected $\chi^2 = 64.9999$, $df = 6$, design-based $F(3.85, 2089.53) = 12.7254$, $p < 0.0001$.
[d]Uncorrected $\chi^2 = 25.6644$, $df = 6$, design-based $F(3.95, 2144.94) = 5.1610$, $p = 0.0004$.
[e]Uncorrected $\chi^2 = 39.0687$, $df = 6$, design-based $F(3.89, 2110.77) = 7.6549$, $p < 0.0001$.
[f]Uncorrected $\chi^2 = 30.4834$, $df = 6$, design-based $F(3.44, 1867.37) = 6.2094$, $p = 0.0002$.
[g]Uncorrected $\chi^2 = 27.9178$, $df = 6$, design-based $F(4.13, 2243.66) = 5.8253$, $p = 0.0001$.

cation from nursing (85.3%), ADE-incident-reporting system (78.5%), alerting orders or trigger medications (71.9%), therapeutic drug monitoring (60.8%), and routine review of laboratory test values (55.7%). Less-commonly used methods included an ADE hotline (29.5%), pharmacists performing rounds independently of physicians (23.6%), medical record E-codes (21.4%), pharmacists performing rounds with physicians to assess ADEs (16.1%), and patient counseling (11.6%). Larger hospitals were more likely to use each of these methods, with the exception of the use of alerting orders or trigger medications and notification from nursing. Smaller hospitals were more likely to use alerting orders or trigger medications than were larger hospitals. Hospitals, regardless of size, all used notification from nursing consistently as a method to monitor patients for ADEs.

Review of ADEs. Most hospitals (89.3%) had a multidisciplinary committee (including physicians, pharmacists, and nurses) responsible for the review and analysis of ADEs and education, policy formulation, and corrective action related to ADEs.

Proactive analysis of risks in the medication-use system can identify opportunities for error before mistakes occur. These risks can be eliminated or minimized by system changes and education. Overall, 66.2% of hospitals had conducted at least one prospective medication-safety-related analytic process using a technique such as failure mode and effects analysis (FMEA) during the past year. This varied significantly with staffed-bed size; larger hospitals were more likely to have completed an FMEA in the past year than were smaller hospitals. For example, 85.2% of hospitals with 600 or more staffed beds completed a prospective medication-safety-related analysis, compared with 45.8% of hospitals with fewer than 50 staffed beds.

Studying errors after they occur to identify their causes is also important. Addressing system weaknesses thought to be the root cause of the errors can reduce the chance of the same error occurring again. Overall, 73.6% of hospitals had conducted at least one retrospective medication-safety-related root cause analysis

Table 5.
Pharmacist Involvement in Therapeutic Drug Monitoring for Inpatients

	Inpatient Pharmacists Routinely Monitor Medication Levels		Pharmacists Have Authority to Order Initial Serum Medication Level[a]		Pharmacists Have Authority to Adjust Dosage for Routinely Monitored Medication[a]		Pharmacists Are Notified When Medication Levels Fall Outside of Therapeutic Range	
Characteristic	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
All hospitals—2009	551	92.3	521	80.1	518	79.2	551	37.9
All hospitals—2006[3]	460	87.8	408	69.1	408	73.2	460	47.3
All hospitals—2003[6]	551	75.5	435	63.3	434	64.6	550	35.5
All hospitals—2000[14]	520	75.6	389	58.6	390	63.1	520	36.5

[a]Of those hospitals that have pharmacists routinely monitor inpatients' medication levels.

(RCA) in the past year. This varied significantly with staffed-bed size; larger hospitals were more likely to have completed an RCA in the past year than were smaller hospitals. For example, 95.2% of hospitals with 600 or more staffed beds had completed a medication-safety-related analysis, compared with 55.4% of hospitals with fewer than 50 staffed beds.

Culture of safety assessment. The Agency for Healthcare Research and Quality (AHRQ) has promoted assessing the culture of safety as an important component of patient safety in hospitals. AHRQ defines *safety culture* in an organization as

> the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management. Organizations with a good safety culture are characterized by communication founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the effectiveness of preventive measures.[16]

Overall, 62.9% of hospitals had conducted a hospitalwide assessment of safety culture such as the AHRQ's *Hospital Survey on Patient Safety Culture.*[16] This varied significantly by hospital size; larger hospitals were more likely to have completed a safety culture assessment than were smaller hospitals (uncorrected χ^2 = 19.6389, *df* = 6, design-based *F*(3.90, 2080.42) = 4.0463, *p* = 0.0031). For example, 79.0% of hospitals with 600 or more staffed beds had conducted a safety culture assessment, compared with 81.4% of hospitals with 400–599 beds, 73.8% of hospitals with 300–399 beds, 66.7% of hospitals with 200–299 beds, 69.0% of hospitals with 100–199 beds, 53.5% of hospitals with 50–99 beds, and 54.3% of hospitals with fewer than 50 staffed beds.

Hospitals have many ways to reflect a safety culture. The most frequently used methods included taking a nonpunitive approach to adverse events (84.6%), promoting errors as an opportunity to learn (75.7%), communicating improvements to staff that result from reported events (67.6%), sharing reporting rates with staff (53.5%), and making adverse-event reports nondiscoverable by plaintiffs in the course of litigation (48.3%). Less-frequently used methods included modifying performance appraisal instruments to reward rather than penalize the reporting of adverse events (19.1%) and providing incentives to staff for reporting (14.4%). Only 2.3% of hospitals had none of these methods in place to reflect a safety culture.

External ADE reporting. Overall, 60.7% of hospitals reported ADEs externally. In 2000, 59.1% of hospitals reported ADEs externally, compared with 52.2% of hospitals in 2003 and 56.1% in 2006.[3,6,14] These results suggest that publication of the Institute of Medicine's report, *To Err Is Human: Building a Safer Health System,*[17] initially stimulated organizational reporting of ADEs externally. The concerns over declines in external reporting, and the resulting decline in opportunities for others to learn from shared error reports and further improve the medication-use system, appear to be abating as external reporting has slightly exceeded the levels reported in 2000.

Of those hospitals that did report ADEs externally, the vast majority reported them to the Food and Drug Administration's MedWatch program (82.8%), followed by relevant state agencies (29.9%), the Institute for Safe Medication Practices (ISMP) Medication Errors Reporting Program (28.7%), manufacturers (28.6%), and the Quantros (formerly the United States Pharmacopeia's) Medmarx system (10.9%). Reporting rates to ISMP have increased during the past three years, from 20.1% of hospitals in 2006, while reporting to the MedWatch program, the Medmarx system, and manufacturers have declined from 88.4%, 13.9%, and 32.3%, respectively.[3]

Patient medication education and counseling. For the purposes of this survey, patient education and counseling were defined as a combination of teaching activities that focus on keeping patients informed about their health condition, treatment plans, medication therapy, and self-care management to facilitate changes in behavior for improvement and maintenance of health. Patient education and counseling may also include incidental, informal, or spontaneous exchanges of information that may be initiated by a specific need, concern, or situation.

Department responsible for counseling. A vast majority of hospitals (89.0%) assigned primary responsibility for performing patient medication education and counseling to nurses. Pharmacists were responsible for performing these tasks in only 5.9% of institutions, and 5.1% of hospitals made these tasks a shared responsibility between nursing and pharmacy or another department. Assignment of responsibility for medication education and counseling had not changed from 2003.[6] In addition, 86.1% of hospitals provided written education materials to patients during medication counseling sessions. This practice has increased from 2003, when 77.8% of hospitals provided patient education and counseling.[6] Patient-specific information used in these medication counseling sessions that includes the patient's name and directions for medication use was provided by 36.2% of hospitals. This varied significantly with hospital size; larger hospitals were less likely to provide patient-specific medication education materials (uncorrected $\chi^2 = 13.1035$, $df = 6$, design-based $F(3.97, 1782.88) = 2.6259$, $p = 0.0335$). For example, 20.8% of hospitals with 600 or more staffed beds provided patient-specific written materials, compared with 37.5% of hospitals with 400–599 beds, 25.8% of hospitals with 300–399 beds, 28.9% of hospitals with 200–299 beds, 28.6% of hospitals with 100–199 beds, 45.0% of hospitals with 50–99 beds, and 43.9% of hospitals with fewer than 50 staffed beds.

Proportion of patients receiving counseling. The majority of hospitals (68.9%) reported that 1–25% of patients received medication education by a pharmacist during their inpatient hospital stay. Only 12.6% of hospitals provided patient medication education by pharmacists to 26% or more of their patients, and 18.6% indicated that no patients received patient education on medications by pharmacists.

The proportion of hospitals providing patient medication education by pharmacists when the patient was discharged was similar; 57.8% had pharmacists provide medication education to 1–25% of patients discharged, 13.0% had pharmacists provide medication education to 26% or more of patients when they are discharged, and 29.3% did not offer discharge counseling by pharmacists. The proportion of patients receiving patient education by pharmacists either during their hospital stay or when patients are discharged has not significantly changed over the past nine years.[3,6,14]

Methods to select patients for counseling. Intensive counseling for every patient is often not practical. Therefore, focusing interventions for specific patients is often necessary. Overall, 43.5% of hospitals used some method to select patients with a greater need for counseling. Of those that did use a method to select patients for counseling, nurse requests, physician orders, and patient requests were used by more than half of hospitals (79.9%, 78.0%, and 67.2%, respectively). The identification of patients on highly complex or high-risk medications (42.4%) was less frequently used. Infrequently used methods included focusing on specific diseases (20.5%), focusing on newly prescribed medications (9.5%), identifying patients with a history of noncompliance (8.4%), focusing on medications with drug–drug interactions (7.0%), and identifying patients discharged on a predetermined high number of medications (5.6%). Only 4.1% of hospitals had pharmacists counsel all patients.

Follow-up after discharge. The National Quality Forum and the Joint Commission have recommendations and standards for discharge planning that include medications. AHRQ also supports hospital discharge protocols that include medications.[18] Recent data suggest that a comprehensive patient discharge plan that includes follow-up with a pharmacist can reduce hospital readmissions by 30%.[19] Overall, 7.2% of hospitals had pharmacist follow-up with high-risk patients about their medications after they are discharged from the hospital. This practice will likely increase as hospitals seek to improve outcomes of patients and prevent readmissions.

Required documentation. Overall, 56.8% of hospitals required pharmacists to document inpatient medication counseling in the patient's medical record.

Strategic practice initiatives. *Pharmacist assignment.* In addition to working in a central pharmacy, pharmacists may be assigned to other areas to review orders, perform rounds with teams, conduct student training and education, answer drug information questions, and interact with patients. We defined *assignment* as eight or more hours per day. If a hospital did not report having these types of patients, it was excluded from that analysis.

For hospitals with these types of services, 65.4% of hospitals assigned pharmacists to critical care areas, 65.2% to medical–surgical areas, 52.1% to oncology areas, and 51.6% to cardiology areas (Table 6). Less than half of hospitals assigned pharmacists to pediatrics areas (42.3%), anticoagulation education services (40.8%), neonatal areas (37.7%), and obstetrics–gynecology areas (35.7%). Less than one third of hospitals assigned pharmacists to specialty services or areas, such as infectious

Table 6.

Percentage of Pharmacists Assigned to Area for 8–24 Hours per Day for Hospitals With These Types of Areas

Characteristic	% Respondents												
	Critical Care (n = 513)	Inpatient Medical–Surgical (n = 531)	Oncology (n = 419)	Cardiology (n = 447)	Pediatrics (n = 408)	Anticoagulation Education Service (n = 459)	Neonatal (n = 382)	Obstetrics–Gynecology (n = 428)	Infectious Diseases Service (n = 465)	Nutrition Support Service (n = 463)	Operating Room–Perioperative Areas (n = 496)	Emergency Department (n = 497)	Pain Control and Palliative Care Service (n = 460)
No. staffed beds													
<50	42.9	59.3	33.3	40.5	35.6	31.0	18.9	30.2	22.0	21.1	20.3	20.3	20.0
50–99	53.0	58.0	40.9	30.0	33.3	30.8	17.1	31.6	28.3	21.9	23.9	25.8	9.8
100–199	68.6	60.6	40.4	45.2	35.2	42.6	31.2	33.3	26.4	34.5	25.4	31.7	20.0
200–299	82.0	71.1	59.7	58.5	40.0	39.2	40.6	26.8	26.2	26.9	25.6	16.0	12.5
300–399	93.8	88.3	85.5	81.4	69.6	66.7	71.9	56.7	56.3	47.3	59.2	52.1	33.3
400–599	92.9	78.6	80.7	78.3	77.3	62.3	76.6	54.8	59.8	44.7	60.3	52.5	33.8
≥600	100	96.6	91.4	94.8	95.7	70.2	90.2	68.0	85.0	67.9	70.2	70.2	40.0
All hospitals—2009	65.4[a]	65.2[b]	52.1[c]	51.6[d]	42.3[e]	40.8[f]	37.7[g]	35.7[h]	32.2[i]	30.3[j]	29.3[k]	28.6[l]	19.9[m]

[a]Uncorrected $\chi^2 = 82.1346$, $df = 6$, design-based $F(3.82, 1933.43) = 16.1853$, $p < 0.0001$.
[b]Uncorrected $\chi^2 = 24.6341$, $df = 6$, design-based $F(3.86, 2023.80) = 5.1672$, $p = 0.0005$.
[c]Uncorrected $\chi^2 = 64.0301$, $df = 6$, design-based $F(3.83, 1576.69) = 10.6102$, $p < 0.0001$.
[d]Uncorrected $\chi^2 = 56.3591$, $df = 6$, design-based $F(3.84, 1687.48) = 9.9429$, $p < 0.0001$.
[e]Uncorrected $\chi^2 = 40.7665$, $df = 6$, design-based $F(3.96, 1589.41) = 8.0418$, $p < 0.0001$.
[f]Uncorrected $\chi^2 = 30.3433$, $df = 6$, design-based $F(3.93, 1774.35) = 5.6407$, $p = 0.0002$.
[g]Uncorrected $\chi^2 = 82.1864$, $df = 6$, design-based $F(3.91, 1467.76) = 13.5489$, $p < 0.0001$.
[h]Uncorrected $\chi^2 = 21.6190$, $df = 6$, design-based $F(3.96, 1669.03) = 4.0184$, $p = 0.0031$.
[i]Uncorrected $\chi^2 = 51.1714$, $df = 6$, design-based $F(3.93, 1798.33) = 9.2956$, $p < 0.0001$.
[j]Uncorrected $\chi^2 = 27.0570$, $df = 6$, design-based $F(3.93, 1792.53) = 4.9885$, $p = 0.0006$.
[k]Uncorrected $\chi^2 = 49.3546$, $df = 6$, design-based $F(3.96, 1935.94) = 9.7388$, $p < 0.0001$.
[l]Uncorrected $\chi^2 = 41.1338$, $df = 6$, design-based $F(3.96, 1942.10) = 8.2868$, $p < 0.0001$.
[m]Uncorrected $\chi^2 = 18.4677$, $df = 6$, design-based $F(4.04, 1830.43) = 3.4423$, $p = 0.0080$.

diseases services, nutrition support services, operating room–perioperative areas, emergency department, and pain control and palliative care services. The largest hospitals were most likely to assign pharmacists to these areas or services.

Cardiopulmonary resuscitation and rapid-response teams. Pharmacist participation on cardiopulmonary resuscitation teams has been associated with decreased patient mortality.[20] On these teams, pharmacists can assist with calculating dosages, providing drug information, compounding parenteral medication, and documenting medications administered. Overall, 40.6% of hospitals had pharmacists participate on cardiopulmonary resuscitation teams.

The Institute for Healthcare Improvement (IHI) has suggested that variation in care affects inpatient mortality rates and that failure to recognize deteriorating patient condition is one systematic issue contributing to patient mortality.[21] IHI recommends establishing a rapid-response team to identify unstable patients and patients likely to suffer medical emergencies and intervene with those patients not in the intensive care unit (ICU) who are rapidly failing before their condition worsens to the point where an ICU admission becomes necessary.[22,23] Hospital directors reported that 15.7% of hospitals had pharmacists participate on rapid-response teams.

Medication reconciliation. Inadequate or incomplete reconciliation of medication orders when the patient transitions from one care area to another has been a long-standing safety concern. Beginning in 2005, the Joint Commission required hospitals to ensure that their processes included the accurate and complete reconciliation of medications at the point of admission, transfer, discharge, or any other handoff to another setting, service provider, or level of care.[24] Over time, hospital pharmacy directors have increasingly reported the development and implementation of approaches to meet the Joint

Commission's medication safety goal on medication reconciliation, from 44.8% of hospitals in 2005 to 78.3% in 2007.[2,4] Overall, 57.3% of hospitals reported using a medication reconciliation process that works well.

Of those hospitals that reported using a medication reconciliation process that works well (n = 274), 32.9% of hospitals cited the use of a specific form for documenting and ordering as the most critical factor contributing to the effectiveness of the process; 22.0% cited the use of information technology. Other factors included specific deployment of a pharmacist (9.0%), institutional leadership's commitment to the process (7.9%), involvement of nursing staff for this purpose (7.2%), and deployment of other staff for this purpose (4.9%). Many cited multiple factors and could not identify a single factor (16.2%).

For hospitals that reported a medication reconciliation process that did not work well (n = 245), the most common barrier to implementing an effective program was a lack of staff resources (37.4%), followed by staff resistance (11.8%), a lack of commitment by institutional leadership (9.3%), nonassignment of responsibility for the process (4.0%), and the hospital not making the process a priority (4.0%). A third of the hospitals that did not have a process that worked well listed other barriers (33.4%). Many cited multiple barriers and could not identify any single barrier.

Technologies. The use of technology has been increasing as a means of improving efficiency and safety in the medication-use system (Table 7).

CPOE. One technique used to improve the prescribing and transcribing steps of the medication-use system is the use of CPOE systems with clinical-decision-support systems (CDSSs). CPOE systems work best when they are part of a comprehensive strategy to improve prescribing practices. The integration of decision-support systems with CPOE is key for improving prescribing. Overall, 15.4% of hospitals had CPOE systems with CDSSs (Table 7). Significantly more of the largest hospitals had CPOE systems than did smaller hospitals. Only 7.4% of hospitals who had CPOE systems did not have their CPOE system integrated with their pharmacy computer system. These systems require manual reentry of orders into the pharmacy computer system by pharmacy staff. Interfaces between systems allow the electronic flow of orders and decrease the opportunity for transcription errors. The increase in the use of interfaces is likely due to the replacement of homegrown legacy systems with enterprise systems that are integrated by design and the movement away from a best-of-breed philosophy toward integrated enterprise medication-use systems. The adoption of CPOE continues to grow slowly.[1-6]

Bar-code-assisted medication administration. The drug administration step is the last in the medication-use system where a medication error can be detected and a potential ADE prevented. Because of the benefits of adding an additional check to the final step in the medication-use system, the adoption of bar-code-assisted medication administration (BCMA) has increased over the past seven years to 27.9% in 2009 (Table 7).[1-7]

Smart infusion pumps. Overall, 56.2% of hospitals used smart infusion pumps (Table 7). The use of smart infusion pumps varied by staffed-bed size. Over 80% of hospitals with 600 or more staffed beds had smart infusion pumps, compared with about 40% of hospitals with fewer than 50 beds. The use of smart infusion pumps has grown from 32% of hospitals in 2005 to nearly 60% in 2009,[1-4] likely due to the replacement of aging legacy pumps that did not have software to check dosages. The slight decline from 2008 to 2009 is likely attributable to the percentage of hospitals with fewer than 50 staffed beds using smart pumps declining from approximately 50% in 2008 to 40% in 2009.

Electronic medical record. Overall, 55.9% of hospitals had one or more components of the medical record (e.g., medication administration record, clinical documentation, recording of vital signs, CPOE, laboratory or radiology results, progress notes) in electronic form (Table 7). Further, 8.8% of hospitals had a complete electronic medical record (EMR) system with no paper records, 47.1% of hospitals had a partial EMR (some components still used paper), and 44.1% had no EMR (all-paper system). This varied by staffed-bed size, with larger hospitals being more likely to have components of an EMR. Overall, 49.9% of hospitals provided pharmacists access to medication-relevant portions of the EMR for the purpose of managing medication therapy. There has been steady growth in the adoption of EMRs in hospitals during the past five years.[2,3,5,6]

Pharmacy practice model. The pharmacy practice model describes how pharmacy department resources are used to provide patient care services. This includes how pharmacists practice and what services are provided in the care of patients, the role of pharmacy technicians in supporting patient 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 automated dispensing cabinets. The use of robotics in the central pharmacy to assist with i.v. preparation and drug distribution has also increased. Clinical training in colleges of pharmacy has increased, with all pharmacy graduates receiving the doctor of pharmacy degree. There is greater emphasis on pharmacy residency training after

Table 7.
Use of Technologies for Medication Safety[a]

Characteristic	n	Complete EMR (No Paper Charts) %	Partial EMR (Some Components Still on Paper) %	No EMR (Paper Charts Only) %	Inpatient CPOE System With CDSS n	Inpatient CPOE System With CDSS %	BCMA n	BCMA %	Smart Infusion Pumps n	Smart Infusion Pumps %
No. staffed beds										
<50	84	9.5	40.5	50.0	84	8.3	84	19.0	84	40.5
50–99	72	8.3	45.8	45.8	72	11.1	72	33.3	72	54.2
100–199	73	11.0	43.8	45.2	73	17.8	73	23.3	73	60.3
200–299	93	5.4	53.8	40.9	93	15.1	93	38.7	92	68.5
300–399	81	8.6	56.8	34.6	81	29.6	81	42.0	81	71.6
400–599	86	7.0	59.3	33.7	85	23.5	86	37.2	86	76.7
≥600	62	6.5	77.4	16.1	62	51.6	62	35.5	62	83.9
All hospitals[b]										
2009	551	8.8	47.1	44.1	550	15.4[c]	551	27.9[d]	550	56.2[e]
2008[1]	…[f]	…	…	…	527	11.4	527	25.1	525	59.1
2007[2]	531	3.8	37.2	59.0	531	10.4	531	19.6	531	41.1
2006[3]	460	38.1[g] combined		61.9	460	8.7	460	13.2	460	37.0
2005[4]	…	…	…	…	510	3.6	510	9.4	510	32.2
2004[5]	492	24.5[g] combined		75.5	492	3.1	493	4.4	…	…
2003[6]	548	30.6[g] combined		69.4	552	2.7	550	3.2	…	…
2002[7]	…	…	…	…	…	…	505	1.5	…	…

[a]EMR = electronic medical record (i.e., computer-based patient record system that provides real-time access to patient medical records), CPOE = computerized prescriber order entry, CDSS = clinical decision-support system, BCMA = bar-code-assisted medication administration.
[b]Estimates exclude federal facilities, Department of Veterans Affairs hospitals, and specialty hospitals.
[c]Uncorrected $\chi^2 = 31.5438$, $df = 6$, design-based $F(3.93, 2135.91) = 6.2450$, $p = 0.0001$.
[d]Uncorrected $\chi^2 = 19.8395$, $df = 6$, design-based $F(3.91, 2127.27) = 3.9831$, $p = 0.0034$.
[e]Uncorrected $\chi^2 = 38.0795$, $df = 6$, design-based $F(3.88, 2109.15) = 7.9242$, $p < 0.0001$.[e]U
[f]Data not collected.
[g]Before 2007, hospitals only reported the presence or absence of EMR, not the current status (complete or partial).

graduation. 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 a "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, 64.7% of hospitals used a patient-centered integrated model, 24.4% used a drug-distribution-centered model, and 10.9% used a clinical-specialist-centered model (Table 8). This varied significantly with staffed-bed 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 ($p < 0.05$). For all sizes of hospitals, the patient-centered integrated model was most common. However, 35.4% of hospitals with fewer than 50 staffed beds used a drug-distribution-centered model, and 45.2% of hospitals with 600 or more staffed beds used a clinical-specialist-centered model. Practice models have not changed significantly from 2008.[1]

Hospital pharmacy directors also provided information about future plans for the pharmacy practice model in their hospital. Overall, 83.6% of hospital pharmacy directors envisioned a patient-centered integrated model, 12.3% envisioned a clinical-specialist-centered model, and 4.1% envisioned a drug-distribution-centered model in the future (Table 8). Hospital pharmacy directors from all sizes of hospitals envisioned a transition toward a more patient-centered integrated model and away from a centralized drug-distribution-centered model. Some pharmacy directors at smaller hospitals envisioned moderate growth in the use of a clinical-specialist-centered model, while some pharmacy directors at larger hospitals envisioned a moderate decline in the use of a clinical-specialist-centered model.

To keep pace with the needs of patients, the desires of personnel, and technological changes, 46.7% ($n = 547$) of hospital pharmacy de-

Table 8.
Philosophy and Future Direction of Pharmacist Deployment in Practice Model

	Current Structure of Pharmacy Practice				Future Direction of Pharmacy Practice			
		Drug Distribution Centered[a]	Patient Centered, Integrated[b]	Clinical Specialist Centered[c]		Drug Distribution Centered[a]	Patient Centered, Integrated[b]	Clinical Specialist Centered[c]
Characteristic	*n*	%	%	%	*n*	%	%	%
No. staffed beds								
<50	82	35.4	64.6	0.0	81	8.6	84.0	7.4
50–99	72	29.2	69.4	1.4	71	1.4	85.9	12.7
100–199	73	20.5	65.8	13.7	73	4.1	83.6	12.3
200–299	93	18.3	64.5	17.2	92	1.1	85.9	13.0
300–399	81	9.9	60.5	29.6	81	0.0	81.5	18.5
400–599	86	5.8	62.8	31.4	85	0.0	80.0	20.0
≥600	62	6.5	48.4	45.2	58	0.0	67.2	32.8
All hospitals—2009	549	24.4[d]	64.7[d]	10.9[d]	541	4.1[e]	83.6[e]	12.3[e]
All hospitals—2008[1]	518	25.8	63.5	10.7	...[f]	...	...	...

[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 $\chi^2 = 95.0334$, $df = 12$, design-based $F(7.73, 4187.42) = 10.9677$, $p < 0.0001$.
[e]Uncorrected $\chi^2 = 27.0593$, $df = 12$, design-based $F(7.44, 3972.58) = 2.6686$, $p = 0.0079$.
[f]Data not collected.

partments were working to change their practice models or had changed their practice model in the past three years. The most common barriers, experienced by 281 hospital pharmacy departments, were a lack of pharmacist staff resources (54.1%), a lack of pharmacy staff with needed training (42.2%), and resistance to change from current staff (34.4%). Other barriers included a lack of automation to support change (27.0%), a lack of hospital leadership support (17.4%), and a lack of qualified technician staff (12.6%). Only 9.7% of hospitals had not experienced barriers to their practice model changes. Staff issues represented significant challenges to envisioned practice models of hospital pharmacy directors.

Standardized i.v. concentrations. The Joint Commission has a national patient safety goal to improve the safety of using medications that includes the standardization and limiting the number of drug concentrations used by hospitals.[25] Overall, 95.1% of hospital pharmacy directors reported effective implementation of standardized i.v. concentrations to promote patient safety. Furthermore, 73.4% of hospitals dispensed more than 75% of large-volume i.v. solutions in standardized concentrations, 17.5% of hospitals dispensed 51–75% of large-volume i.v. solutions in standardized concentrations, 6.8% of hospitals dispensed 26–50% of large-volume i.v. solutions in standardized concentrations, and 2.3% of hospitals dispensed 25% or less of large-volume i.v. solutions in standardized concentrations.

Restricted drug distribution programs. Restricted drug distribution programs require pharmacies, prescribers, or patients to register and agree to certain program criteria (e.g., education, monitoring) before a drug is dispensed, with some allowing the drug to be dispensed only through an exclusive distributor. Examples of medications that are part of restricted distribution programs include clozapine, dofetilide, and isotretinoin. These programs can be time-consuming and add an additional administrative burden to pharmacy operations. As risks associated with medication use increase, additional medications may also be made available through these restricted distribution programs.

Overall, 48.5% of hospital pharmacy departments dispensed medications that were part of restricted drug distribution programs. This varied significantly by staffed-bed size; larger hospitals were more likely to access medications through these restricted distribution programs than were smaller hospitals. For example, only 20.2% of hospitals with fewer than 50 staffed beds dispensed medications through these programs, compared with 40.3% of hospitals with 50–99 staffed beds, 57.5% of hospitals with 100–199 beds, 68.8% of hospitals with 200–299 beds, 85.2% of hospitals with 300–399 beds, 84.9% of hospitals with 400–599 beds, and 91.9% of hospitals with 600 or more staffed beds. Hospitals dispensed medications through these programs to a mean ± S.E. of 8.8 ± 1.3 patients per month. This also varied significantly by staffed-bed size; larger hospitals dispensed medications to more patients per month than did smaller hospitals. Hospitals with fewer than 50 staffed beds dispensed medications through these programs to an average of 2.1 patients per month, compared with 4.8 patients per month for hospitals with 50–99 staffed beds, 4.6 patients per month for hospitals with 100–199 beds, 3.8 patients per month for hospitals with 200–299 beds, 9.9 patients per month for hospitals with 300–399 beds, 18.0 patients per month for hospitals with 400–599 beds, and 59.7 patients per month for hospitals with 600 or more staffed beds.

Accreditation. Overall, 71.4% of hospitals were accredited by the Joint Commission, 19.9% were not accredited by an external organization and were state licensed, 3.5% were accredited by the American Osteopathic Association Healthcare Facilities Accreditation Program, 1.2% were accredited by DNV Healthcare, and 4.0% were accredited by more than one accrediting body.

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

Hours of operation. For all hospitals, inpatient pharmacy services were provided an average of 112 hours per week (Monday through Sunday), with smaller hospitals and health systems having fewer service hours per week than larger hospitals. For example, pharmacy departments were open an average of 67.5 hours per week in hospitals with fewer than 50 staffed beds, compared with 89.4 hours for hospitals with 50–99 beds, 129.9 hours for hospitals with 100–199 beds, 152.4 hours for hospitals with 200–299 beds, and over 165 hours per week for hospitals with 300 or more staffed beds. The average number of hours pharmacy departments were open and available to provide services has increased from 101 hours in 2005 and 2006, to 103.8 hours in 2007, and 106.2 hours in 2008.[1-4]

An estimated 41.2% of hospitals provided 24-hour inpatient pharmacy services. This also varied significantly by staffed-bed size; the larger the hospital, the higher the percentage that provided 24-hour inpatient pharmacy services. For example, only 8.8% of hospitals with fewer than 50 staffed beds provided 24-hour inpatient pharmacy services, whereas 98.4% of hospitals with 600 or more staffed beds provided 24-hour inpatient pharmacy services. The percentage of hospitals providing 24-hour services has significantly increased over the past four years from 30.2% of hospitals in 2005.[4]

Product acquisition cost. Inpatient pharmaceutical acquisition costs included all drug products, blood products, and diagnostic agents but excluded i.v. fluids and sets. Larger hospitals had higher inpatient and outpatient expenditures. The average inpatient acquisition cost per patient day was $156, and the average inpatient acquisition cost per admission was $698 (Table 9).

Outpatient pharmaceutical acquisition costs included drug products dispensed from an outpatient pharmacy and other ambulatory care settings (e.g., oncology clinics, outpatient surgery centers). Compared with 2008, the average outpatient pharmaceutical acquisition cost increased by 39%.[1]

Inventory turnover. Inpatient pharmacy inventory turnover was defined as follows: "Inventory turns per year is typically calculated by dividing 'total purchases' by 'inventory on hand' or 'average of beginning and ending inventory at cost.'" The average inventory turnover rate was 9.5. Inventory turnover varied significantly by hospital size; larger hospitals had higher inventory turnover. The average inventory turnover rates were 7.0 in hospitals with fewer than 50 staffed beds, 8.1 in hospitals with 50–99 beds, 9.8 in hospitals with 100–199 beds, 11.0 in hospitals with 200–299 beds, 13.1 in hospitals with 300–399 beds, 13.4 in hospitals with 400–599 beds, and 13.7 in hospitals with 600 or more staffed beds. The rate of inventory turnover was similar to that reported in 2006 (9.8).[3]

Staffing. The number of full-time-equivalent (FTE) pharmacists (1 FTE = 40 hours per week) averaged 11.5 and varied significantly by hospital size (Table 10); the larger the hospital, the greater the number of FTE pharmacists. The number of FTE technicians averaged 9.9 and also varied significantly by hospital size. As with FTE pharmacists, the larger the hospital, the greater was the number of FTE technicians.

The average number of FTE pharmacists and FTE technicians per 100 occupied beds (average daily census) among all hospitals was 18.4 and 16.9, respectively (Table 10). These values varied significantly by hospital size, with the smallest hospitals having the most FTE pharmacists and technicians per 100 occupied beds.

The average numbers of FTEs per 100 occupied beds for management, clinical, distributive, integrated, informatics, medication-use safety, and other pharmacists by number of staffed beds are provided in Table 11, as are FTEs per 100 occupied beds for residents, pharmacy technicians, and support staff.

To compare a hospital's staffing levels to the national average, readers should find the average number of FTEs per 100 occupied beds in the category of staffed beds that fits their institution, multiply that number by the number of staffed beds in their hospital, and divide by 100.

The allocation of FTEs across different types of pharmacist and nonpharmacist staff varied greatly by hospital size, clinical versus distributive pharmacist designations, and the presence of integrated pharmacists who spend approximately equal

Table 9.
Inpatient Pharmacy Acquisition Cost of Pharmaceuticals per Patient Day and per Admission

	Total Inpatient Pharmacy Acquisition Cost of Pharmaceuticals[a] per Patient Day ($)		Total Inpatient Pharmacy Acquisition Cost of Pharmaceuticals[a] per Admission ($)	
Characteristic	***n***	**Mean ± S.E.**	***n***	**Mean ± S.E.**
No. staffed beds				
<50	67	182.93 ± 18.04	67	730.49 ± 143.63
50–99	52	162.79 ± 28.12	52	585.05 ± 74.52
100–199	62	171.29 ± 48.38	62	818.90 ± 226.36
200–299	82	109.20 ± 5.28	81	598.58 ± 43.43
300–399	75	120.02 ± 7.13	75	605.09 ± 36.03
400–599	78	123.88 ± 8.69	77	656.61 ± 38.73
≥600	58	111.90 ± 5.84	58	721.03 ± 58.52
All hospitals—2009	474	156.14 ± 13.02	472	697.79 ± 70.62
All hospitals—2008[1]	389	170.08 ± 15.37[b]	389	716.95 ± 69.90[b]
All hospitals—2007[2]	414	156.28 ± 13.82[b]	416	702.08 ± 55.47[b]

[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. sets."
[b]Data from 2007–08 were reanalyzed using the format adopted in 2009.

amounts of time in clinical and distributive activities.

Staff vacancies and turnover. An estimated 3.7% of FTE pharmacist positions and 4.1% of FTE pharmacy technician positions were vacant (Table 10). The percentage of vacant FTE positions was calculated by dividing the number of vacant FTE positions by the total number of FTE positions overall and within each category of staffed-bed size.

The current U.S. economic recession has affected recruitment efforts to fill vacant positions. While the overall rate of pharmacist vacancies has declined (Table 10), 25% of the positions were "frozen," meaning that directors were not authorized to recruit and hire replacements for these positions. Similarly, the rate of pharmacy technician vacancies has declined from 2008 (Table 10); however, 33% of these positions were frozen. On average, directors reported that vacant pharmacist and technician positions were filled in 5.1 and 1.8 months, respectively.

Inpatient pharmacy staff turnover rates are presented in Table 10. The overall rate of pharmacist and pharmacy technician turnover was 6.6% and 13.4%, respectively. Of this pharmacist turnover, 18% was due to terminations, and 82% were voluntary resignations. Of the pharmacy technician turnover, 24% was due to terminations, and 76% were voluntary resignations.

Space. The use of space for general nonsterile drug preparation and dispensing, compounding sterile preparations, drug storage, office space, and other space varied significantly by hospital size, with the largest hospitals having the most space. Reported space allocations were similar to those found in the 2006 survey.[3]

The average pharmacy department space was 20.4 ft^2 per staffed bed. Space per staffed bed varied significantly by hospital size; larger hospitals had less space per staffed bed than did smaller hospitals. For example, hospitals with fewer than 50 staffed beds reported 31.2 ft^2 per staffed bed, compared with 19.2 square feet per staffed bed in hospitals with 50–99 beds, 15.1 square feet per staffed bed in hospitals with 100–199 beds, 11.9 square feet per staffed bed in hospitals with 200–299 beds, 10.9 square feet per staffed bed in hospitals with 300–399 beds, 10.1 square feet per staffed bed in hospitals with 400–599 beds, and 10.3 square feet per staffed bed in hospitals with 600 or more staffed beds.

Hospital departments allocated 41% of their space to general nonsterile drug dispensing, 17% to compounding sterile preparations, 26% to drug storage, 17% to office space, and 24% to other uses. Overall, over half of respondents indicated that their current space allocations were adequate for general nonsterile drug dispensing (61.8% of respondents), compounding sterile preparations (64.6%), drug storage (54.7%), office space (57.7%), and other uses (56.9%).

Summary and conclusion

In this national probability sample survey, the response rate was 40.5%. Pharmacists were very involved in monitoring medication therapy in hospitals. Virtually all hospitals had pharmacists regularly monitor medication therapy. Nearly half of respondents reported that pharmacists monitored 75% or more of patients. An increasing percentage of hospitals provided pharmacists electronic access to laboratory test data. Students were increasingly conducting moni-

Table 10.
Inpatient Pharmacy Staffing in Prior Fiscal Year

Characteristic	*n*	Mean ± S.E. No. FTE Pharmacists[a]	Mean ± S.E. No. FTE Pharmacists per 100 Occupied Beds	% Vacant FTE Pharmacist Positions[b]	% Pharmacist Turnover[c]	Mean ± S.E. No. FTE Pharmacy Technicians	Mean ± S.E. No. FTE Technicians per 100 Occupied Beds	% Vacant FTE Technician Positions[b]	% Pharmacy Technician Turnover[c]
No. staffed beds									
<50	84	2.3 ± 0.2	23.6 ± 2.9	5.2	9.9	2.4 ± 0.3	22.2 ± 3.2	4.1	13.2
50–99	72	4.7 ± 0.4	25.8 ± 13.2	3.4	8.9	4.6 ± 0.5	26.7 ± 14.7	1.2	11.0
100–199	73	11.7 ± 1.8	16.4 ± 4.7	4.0	6.6	9.8 ± 1.2	13.1 ± 3.1	5.7	14.3
200–299	90	14.1 ± 0.7	9.0 ± 0.4	3.5	7.5	13.0 ± 0.7	8.2 ± 0.4	4.2	13.4
300–399	79	25.6 ± 1.3	10.4 ± 0.5	3.0	5.4	22.0 ± 1.0	9.0 ± 0.4	3.6	13.1
400–599	82	35.7 ± 1.6	12.4 ± 1.6	3.5	5.7	28.9 ± 1.3	9.1 ± 0.6	4.0	13.4
≥600	58	64.5 ± 3.3	10.9 ± 0.5	3.7	5.9	51.8 ± 3.3	8.6 ± 0.5	3.9	13.8
All hospitals—2009	538	11.5 ± 0.5[d]	18.4 ± 2.4	3.7	6.6	9.9 ± 0.3[e]	16.9 ± 2.5	4.1	13.4
All hospitals—2008[1]	520	11.2 ± 0.3	14.2 ± 1.0	5.9	8.6	9.9 ± 0.2	13.1 ± 0.9	4.7	13.8
All hospitals—2007[2]	525	10.2 ± 0.3	13.2 ± 0.6	6.3	7.6	9.5 ± 0.3	13.0 ± 0.7	4.1	13.7
All hospitals—2006[3]	451	9.8 ± 0.4	15.1 ± 2.3	5.7[f]	...[g]	9.0 ± 0.3	11.8 ± 1.6	...	...
All hospitals—2005[4]	506	10.1 ± 0.3	13.1 ± 0.8	6.3[f]	...	9.7 ± 0.3	12.3 ± 1.2	...	...
All hospitals—2004[5]	489	9.8 ± 0.3	12.3 ± 0.6	5.7[f]	...	9.1 ± 0.3	11.6 ± 0.7	...	...
All hospitals—2003[6]	537	9.4 ± 0.4	10.9 ± 0.4	4.7[f]	...	8.6 ± 0.3	10.1 ± 0.2	...	...
All hospitals—2002[7]	503	8.6 ± 0.3	10.4 ± 0.5	7.2[f]	...	8.4 ± 0.3	10.0 ± 0.6	...	...

[a]FTE = full-time equivalent.
[b]Calculated as number of vacant FTE positions divided by total number of FTE positions.
[c]Calculated as number of FTE resignations divided by total number of FTE positions.
[d]Design-based $F(1, 531) = 37.72$, $p < 0.0001$.
[e]Design-based $F(1, 526) = 113.34$, $p < 0.0001$.
[f]Data from 2002–06 were reanalyzed using the method adopted in 2007 for consistency. Calculated as number of vacant FTE positions divided by total number of FTE positions.
[g]Data not collected.

toring activities. More than 92% of hospitals had pharmacists routinely monitor serum medication concentrations or their surrogate markers. Most hospitals allowed pharmacists to order initial serum concentrations and adjust dosages. Genetic testing to evaluate indication or dosage was done in only 2.7% of hospitals.

Pharmacist involvement in medication safety initiatives continued to be strong, interconnected to others in the medication-use system, and focused on the system. Interdisciplinary committees reviewed ADEs in 89.3% of hospitals. Prospective analysis (e.g., FEMA) was conducted in 66.2% of hospitals; retrospective analysis (e.g., RCA) was conducted in 73.6%. Safety culture had been assessed by 62.8% of hospitals. ADEs were reported to external groups by 60.7% of hospitals.

Pharmacist involvement in patient education programs continued to be modest. Most hospitals assigned oversight for patient medication education to the department of nursing, but many hospitals reported that pharmacists provided medication education to 1–25% of patients. The percentage of patients who received education from pharmacists did not change significantly over the past nine years.

The use of technology continues to improve the medication-use system. CPOE systems with CDSSs were in place in 15.4%, BCMA systems in 27.9%, smart infusion pumps in 56.2%, and complete EMR systems in 8.8% of hospitals. The majority of hospitals used an integrated pharmacy practice model using clinical generalists, and the majority of directors favored this model for the future.

Pharmacists play a significant role in emergency response services in hospitals. Approximately 40% of hospitals had pharmacists as members of cardiopulmonary resuscitation teams, and 15.7% had pharmacists participate on rapid-response teams.

Table 11.
Pharmacy Full-Time Equivalents (FTEs) per 100 Occupied Beds by Type of Position

		Mean FTEs per 100 Occupied Beds[a]										
Characteristic	*n*	Management Pharmacists	Clinical Pharmacists	Distributive Pharmacists	Integrated Pharmacists	Informatics Pharmacists	Medication-Use Safety Coordinator Pharmacists	Other Pharmacists	Residents	Total Pharmacists	Total Pharmacy Technicians	Total Other Support Staff
No. staffed beds												
<50	80	6.9	1.1	2.8	12.2	0.31	0.02	0.03	0.24	23.6	22.2	0.26
50–99	67	3.2	0.7	5.0	16.7	0.13	0.10	0	0	25.8	26.7	0.70
100–199	70	2.0	1.1	3.0	8.8	0.51	0.09	0.12	0.71	16.4	13.1	1.22
200–299	87	1.1	0.9	2.2	4.4	0.17	0.05	0.04	0.16	9.0	8.2	0.55
300–399	78	1.1	1.9	2.8	3.8	0.28	0.08	0.08	0.42	10.4	9.0	0.66
400–599	80	1.4	1.2	2.8	5.9	0.25	0.11	0.16	0.60	12.4	9.1	0.68
≥600	58	1.0	2.0	2.4	4.1	0.23	0.12	0.22	0.89	10.9	8.6	0.68
All hospitals—2009	520	3.60[b]	1.10	3.07	9.87	0.30	0.06	0.06	0.35	18.4	16.9	0.64
All hospitals—2008[1]	516	2.67	1.15	2.99	6.71	0.18	0.09	0.07	0.23	14.2	13.1	0.71
All hospitals—2007[2]	501	2.66	1.14	3.26	5.51	0.26	0.13	0.13	0.11	13.2	13.0	1.05
All hospitals—2006[3]	434	2.60	1.04	3.09	7.94	0.21	0.08	0.03	0.13	15.1	11.8	0.31
All hospitals—2005[4]	505	2.5	1.0	3.4	5.1	0.2	0	0.4	0.3	13.1	12.3	0.7

[a]Standard errors are available upon request.
[b]Design-based $F(1, 513) = 8.82$, $p = 0.0031$.

Hospital pharmacy practice is becoming increasingly integrated, with pharmacists having both distribution and clinical roles. Almost two thirds of hospitals used a patient-centered integrated model that included clinical generalists performing both distributive and clinical activities. More than 83% of respondents favored this model for the future over separate distribution and clinical specialist roles.

Pharmacy service hours continued to increase in hospitals, with 41.2% offering around-the-clock services. Vacancy rates decreased, with 3.7% of pharmacist positions and 4.1% of technician positions being vacant.

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