

Information Technologies Relevant to Pharmacy Practice in Hospitals: Results of a Statewide Survey

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Abstract

Purpose: To evaluate the extent that Florida hospitals are utilizing a variety of pharmacy-related information technology (IT) applications and contrast these results with nationwide studies regarding IT.

Methods: Chief Information Officers of Florida acute care hospitals were surveyed from May through October 2003. Facilities were questioned on the utilization of clinical and other IT applications, priorities, and barriers. The results of the questionnaire along with differences between small and large hospitals were examined.

Results: Overall, few hospitals have adopted computerized physician order entry (CPOE) and bar coded medication management (15.8% and 12.6% respectively), and only slightly more than half (50.5%) have adopted a computer-based patient record (CPR) system. Although utilization of these did not differ between small and large hospitals, larger hospitals were more likely to have a pharmacy information system (100% vs 69.6%, $P = 0.004$) and an automated pharmacy dispensing system (82.6% vs 30.4%, $P < 0.001$). Larger hospitals were also more likely to utilize most medical information retrieval services. Implementing technology to reduce medical errors and promote patient safety was cited by facilities as their number one IT priority, and lack of adequate financial support was cited as the single most important barrier to implementing IT. These results were comparable with other nationwide studies.

Conclusions: Florida hospitals, similar to previous hospitals studied nationwide, were found to have a slow rate of adoption of pharmacy-related IT. As a result, pharmacists are encouraged to play a more active role in collaborating with hospital leaders in order to implement these technologies at their facilities in an effort to reduce medication errors and improve the quality of care delivered to patients.

Key Words — hospital IT; pharmacy IT; medication errors

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Although medical errors occur in a variety of health care situations and processes, many of the most serious errors occur in the process of prescribing, transcribing, dispensing, administering, or monitoring medication.^{1,2} Many of these medication errors are preventable events that may cause or lead to inappropriate medication use or patient harm.¹ In fact, drug errors cause the death of one person every day in the US and injure more than a million people each year.³ In addition to causing morbidity and mortality, the financial consequences are also significant, costing the health care system an estimated \$17 to \$29 billion annually.⁴ The Institute of Medicine suggests that most of these errors occur as a result of imperfectly designed systems and are not typically due to the negligence of caring individuals. Given the system-related nature of errors, information technology (IT) holds promise in improving care in hospitals.^{5,6}

Pharmacists who are routinely involved in managing and improving the medication use process can benefit from a variety of available technologies.⁷⁻⁹ Examples of such technologies believed to reduce medication-related errors and improve quality outcomes include: computerized physician order entry (CPOE), bar coded medication management, handheld personal digital assistants, and inter-

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Table 1. Hospital and CIO Demographics for Surveyed Florida Facilities

<i>Hospital</i>	<i>Results (N = 95)</i>
Hospital affiliation	
Stand alone	28.4% (n = 27)
System-affiliated	71.6% (n = 68)
Profit status	
Not-for-profit	64.1% (n = 61)
For-profit	28.3% (n = 27)
Government	7.6% (n = 7)
Urban vs Rural^a	
Urban	71% (n = 67)
Rural	29% (n = 28)
Beds: mean (range)	330 (15 to 1,862)
Number of full-time employees: mean (range)	51.38 (0 to 256)
Chief Information Officer	
Results	
Gender	
Male	65.3% (n = 62)
Female	34.7% (n = 33)
Age (in years)	
20 to 29	1.1% (n = 1)
30 to 39	24.5% (n = 23)
40 to 49	50.0% (n = 48)
50 to 59	24.5% (n = 23)
Greater than or equal to 60	0% (n = 0)
Length at current position: mean (range)	4.5 years (3 months to 25 years)
^a Statutorily defined rural hospitals by the Florida Department of Health	

net access to medical reference material.^{10,11} Previous nationwide studies, surveying pharmacy directors, have explored the adoption of pharmacy related IT.^{7,8,12} Despite the important contribution of these studies, little is known specifically about the utilization of these technologies in Florida community hospitals. Florida is unique because it has the highest proportion of elderly in the US.¹³ This is significant given the elevated risk of medication errors¹⁴ and inappropriate medication use¹⁵ in this

group because of their extensive use of drugs.¹⁵⁻¹⁷ Therefore, the purpose of the current study was to evaluate the extent that Florida hospitals are utilizing a variety of pharmacy-related IT applications. In addition, given that our data was collected from surveys of hospital Chief Information Officers (CIOs), our results can be contrasted with nationwide studies regarding IT that targeted pharmacy directors.

METHODS

The information presented here, which is part of a larger study,¹⁸⁻²¹ includes results from a survey mailed between May and October 2003 to all acute care hospitals (N = 199) in Florida. A list of these hospitals along with contact information was obtained from the Florida Hospital Association. The survey was designed to assess the use of clinical and other IT applications in the acute care hospital setting. Each facility was also asked to identify their IT priorities as well as any barriers that may prevent them from achieving these goals. Questions pertaining to facility and individual demographics as well as questions regarding quality and patient safety IT were also asked. The CIO or equivalent employee of each acute care facility was responsible for completing the survey. Prior to its use, the survey instrument was pretested with a CIO and other IT experts located in a neighboring state.

Since research suggests that hospital size may influence IT adoption,²² we compared responses from small and large hospitals by computing first and last quartiles for hospital bed size. Analyses included descriptive statistics and chi-square test with two-tailed significance levels considered at $P < 0.05$. All analyses were conducted using a predictive analysis program that uses statistics called SPSS version 11.5 (SPSS Inc., Chicago, IL)

RESULTS
Demographics

A total of 199 surveys were mailed. After one survey was returned to sender for an incorrect address, numerous attempts to contact the hospital and correct the address failed. As a result, it was assumed that the hospital was no

longer in existence and that survey was excluded. Of the remaining 198 invited hospitals, 95 hospitals completed the survey for a response rate of 48%. Hospital demographics are listed in Table 1. The average number of staffed inpatient beds was reported to be 330 (95% CI = 244.69, 415.31); however, this number was highly variable with the number of beds ranging from 15 to 1,862 (median = 143.5). When assessed by distribution, 25% of hospitals had 55 or fewer beds, and 75% of hospitals had 470 or fewer beds. The number of full-time employees (FTEs) in the IT department at each facility was also highly variable with the number ranging from 0 to 256 FTEs (median = 20). Respondents completing the survey predicted this number to increase over the next 12 months by an average of 1.3 full-time positions (range = -10 [negative sign indicating a decrease] to 30).

In addition to answering questions based on hospital demographics, CIOs completing the survey were also asked to provide information about themselves. See Table 1 for a complete description of CIO demographics. In general, the majority of those responding were males between the age of 40 and 49 years old, and the average length of time respondents reported being at their current position was 4.5 years (95% CI = 3.57, 5.32).

Clinical IT Systems

Information on the utilization of pharmacy information systems, automated pharmacy dispensing systems, computer-based patient record (CPR) systems, bar coded medication management, and CPOE systems was obtained. Detailed reviews are available for those readers unfamiliar with these

systems.²³⁻²⁸ Comparisons between small and large hospitals were made to detect any differences in the utilization of these information technologies. Results of these comparisons can be found in Figure 1.

Pharmacy-related IT

Almost all (85.3%) of responding facilities reported currently using a pharmacy information system, with an additional 8.4% planning to do so within the next 2 years. Larger hospitals were more likely to be currently using a pharmacy IT system (100% vs 69.6%, $P = 0.004$). Only 64.2% indicated that they currently use some type of automated pharmacy dispensing system (eg, a robotic automated dispensing system). Significant differences existed between small and large hospitals, with only 30.4% of small hospitals reporting the use of an automated system vs 82.6% of large hospitals ($P < 0.001$). Of those not currently using an automated system, 23.2% plan to do so within the next 2 years.

CPR System

Respondents were asked to describe the status of their facility's current use of a CPR system. While only 30.5% of responding facilities reported having a fully operational CPR system in at least one area of the hospital, an additional 20% stated they have at least begun the installation process. No significant differences were found between small and large hospitals. Of those not currently using or implementing CPR, 28.4% plan to use it within the next 2 years.

Bar Coded Medication Management

Although 40% of those responding reported having bar coding technology at their facility, only 12.6% stated they use this

technology for medication management. These findings were similar for both small and large hospitals. Despite the low percentage of hospitals currently using this technology for the management of medications, 61.1% did indicate that they plan to begin using this technology within the next 2 years.

CPOE System

When questioned on the status of their facilities current use of a CPOE system, only 11.6% reported having a fully operational system in place in at least one area of the hospital with an additional 4.2% stating they had begun the installation process. Approximately half (49.5%) of the respondents reported they had not begun to plan for the use of CPOE. These findings did not differ between small and large hospitals.

Medical Information Retrieval Services

Facilities were asked to indicate which medical information retrieval services (chosen from a list) their hospital provides to health care clinicians for use in patient care. Overall, the majority of hospitals (76.8%) reported using a library that supplies printed books and journals. Electronic access to free databases was also commonly cited (68.4%). With the exception of handheld personal digital assistants (PDAs) (in which no significant differences existed), smaller hospitals were consistently less likely to utilize the medical information retrieval services described above when compared with larger hospitals. For a complete list of responses with comparisons based on hospital size, see Table 2.

IT Priorities and Barriers to Implementation

Table 2. Medical Information Retrieval Services in Surveyed Florida Facilities

Retrieval Service	% of Hospitals Utilizing Service			
	Overall	Large Hospitals (n = greater than or equal to 470 beds)	Small Hospitals (n = less than or equal to 55 beds)	P-value*
Printed books and journals in a hospital library	76.8%	100%	47.8%	Less than 0.001
Electronic access to free databases (eg, <i>PubMed</i> and <i>TOXNET</i>)	68.4%	45.7%	19.6%	Less than 0.001
Intranet resource tools (eg, <i>Micromedex</i>)	62.1%	82.6%	26.1%	Less than 0.001
Access to information through affiliation with a hospital consortia or medical school	51.6%	82.6%	30.4%	Less than 0.001
Personnel trained to do medical searching at MD's request	45.3%	82.6%	30.4%	Less than 0.001
Handheld personal digital assistants	29.5%	30.4%	26.1%	0.743

*Represents difference between small and large hospitals

CIOs completing the survey were asked to identify their facility's top five IT priorities (chosen from a list of 20 issues), both today and within the next 2 years. Implementing technology to reduce medical errors and promote patient safety was cited by the facilities as their number one IT priority (currently and within the next 2 years), with more than half (52.6%) of the respondents ranking it as their number one priority today and 60.0% ranking it as their number one priority within the next 2 years. Although large hospitals were significantly more likely to list this as a priority today (73.9% vs 39.1%, $P = 0.017$), this difference no longer existed when comparing priorities over the next 2 years. Other current priorities cited by the facilities were implementing wireless systems (42.1%), replacing/upgrading inpatient clinical systems (42.1%), upgrading secu-

urity on IT systems to meet HIPPA requirements (37.9%), and implementing privacy modifications to meet HIPPA requirements (28.4%).

Respondents were further asked to state what they felt was the single most important barrier to implementing IT at their facility today. Lack of adequate financial support for IT was the most frequently cited (30.5%), with no differences found between large and small hospitals. Other barriers commonly listed were vendor's inability to effectively deliver products or services (12.6%), difficulty in achieving end-user acceptance or use (11.6%), and lack of common data standards (10.5%).

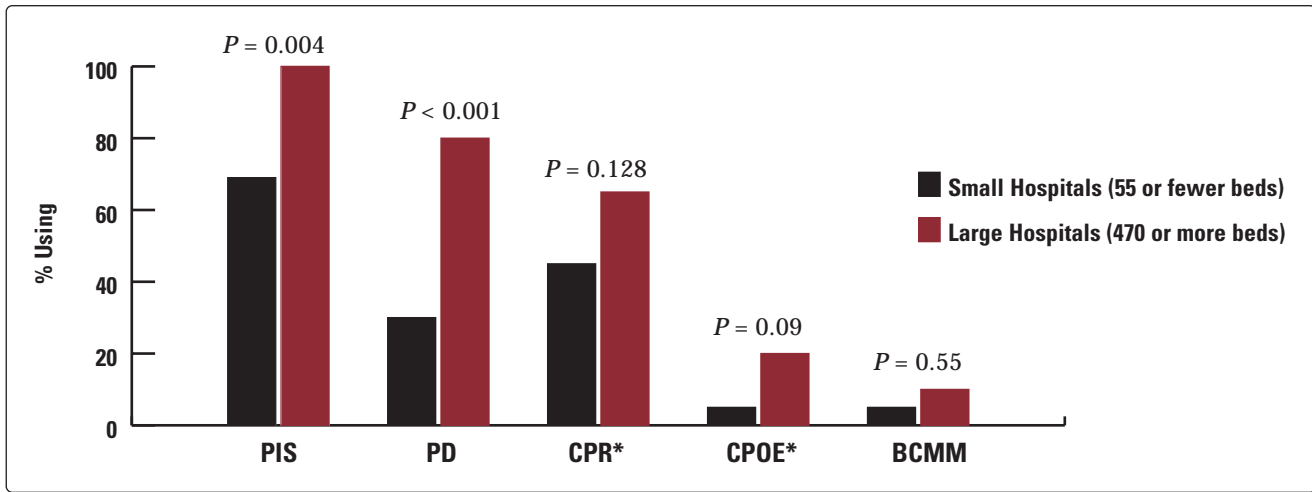
DISCUSSION

Medication errors result in significant clinical, emotional, and financial consequences. The literature identifies numerous technologies that are associated with pre-

venting errors and improving health care quality. In this study, we examine the extent that these technologies are utilized in community hospitals in Florida. Our analysis indicates that significant differences exist between small and large hospitals.

For example, all large hospitals in the present study indicated currently using a pharmacy information system, and over 80% indicated using an automated pharmacy dispensing system. On the other hand, only about two-thirds of the larger hospitals and less than a third of the smaller hospitals use these technologies respectively. These findings are consistent with recent reports indicating that smaller hospitals are more likely to outsource pharmacy operations to a contract pharmacy services provider.⁸

Other important findings of the current study suggest that,



PIS = pharmacy information system, PD = pharmacy dispensing system, CPR = computer-based patient record system, CPOE = computerized physician order entry, BCMM = bar coded medication management
 *Indicates those that have begun to install or are fully functional

Figure 1. Florida's current hospital utilization of select clinical IT applications

overall, few hospitals have adopted CPOE and bar coded medication management, and only slightly more than half use a CPR system. This is particularly troubling given that health IT research suggests that these technologies are particularly effective in preventing errors.²⁹⁻³¹ Additionally, no differences were found, for these technologies, between small and large hospitals which may indicate one of two possible reasons. First, the recent high media and literature visibility of these technologies^{5,10,11,32} may prompt smaller hospitals to be more aware of and therefore more readily utilize these technologies. Secondly, given that larger hospitals are significantly more likely to have all other information technologies examined in this study, CPOE, bar coded medication management and CPR may be in the early stages of product adoption, and as such it may be too early to detect differences between small and large hospitals. Further attention into how these innovations are incorporated into

hospital practice should be followed over the coming years.

Pharmacists are challenged with having to keep track of a growing body of knowledge related to their practice. With more than two dozen drugs coming to market each year,³³ it becomes increasingly more difficult to stay abreast of new developments. For this reason, medical information retrieval services are available to help guide clinical decision making at the point of care.¹⁰ Overall, larger hospitals are more likely to utilize medical information retrieval services. This is true of all the retrieval services studied with the exception of handheld PDAs. The resource intensive requirements needed to maintain internet, intranet, and print reference material may be cost prohibitive for smaller hospitals. These findings also present a challenge for smaller hospitals whose clinicians may have a difficult time accessing medical information as a result of limited resources. However, the recent price-drop in handheld computing

may have increased the feasibility to equipping clinicians with this important technology. We expect PDAs to become more pervasive in hospital practice over time, given their portability, affordability, and increasing ease of use.

The data presented in the current study suggests that implementing technology to reduce medical errors is a priority, both currently and over the next few years, for hospital IT leaders. Furthermore, existing evidence suggests that when clinicians and hospital IT staff work collaboratively, patient safety-related IT is more likely to be adopted.¹⁹ This creates an opportunity for pharmacists who, as drug experts in their organizations, can educate administrators and IT professionals about the availability of technologies suitable for preventing medication errors.

Financial resources were cited as a common barrier for small and large hospitals alike. As such, pharmacists can be of particular help in prioritizing these technologies so that decision makers can

maximize the impact of their investments in these technologies. This is of particular importance given that some states (eg, CA) are requiring that hospitals implement IT interventions to reduce medication related errors.¹⁰ Other states are currently considering implementing similar legislation¹¹ (with no additional financial support typically being awarded). As a result, smaller hospitals with a lack of resources may find it difficult to implement these technologies to improve patient care if the current trend in IT adoption continues. Future research should focus on examining strategies that can be employed by smaller hospitals.

The findings of the current study are of importance to pharmacists for additional reasons. First and foremost the technologies examined have been demonstrated to have various clinical and organizational advantages associated with their use. For example, CPOE and bar coded medication management systems are associated with a reduction of medication errors and improved efficiencies in hospitals.^{29,30} Additionally, CPR is associated with both improved patient and organizational outcomes³¹ as well as increased provider satisfaction.³⁴ Moreover, a recent survey of pharmacists indicated that many pharmacy managers perceived these technologies to reduce the occurrence of drug errors.¹² Nevertheless, the literature also suggests that many IT applications, some that are discussed in the present study, are promising for improved patient safety but currently lack strong evidence to support this claim due to the lack of randomized trials.³⁵

Our study results are comparable in many aspects with previously published work of a national scope.^{7,8,12} For example, our study

indicated that 64.2% of acute care hospitals in Florida currently use some type of automated pharmacy dispensing system. This is comparable with the American Society of Health-System Pharmacists (ASHP) national survey results in which 66% of hospitals reporting using this technology (7.8% reported using a robotic distribution, while 58.2% reported the use of a point-of-use dispensing device).⁸ Additionally, 11.6% of the hospitals responding to our survey reported that a fully operational CPOE system was in place in their hospital, which is similar to the results (10.7%) found by Schumock and colleagues¹² (although both of these are higher than the 4.3% reported in ASHP's national survey⁷). Acute care hospitals in Florida did rank higher in the use of bar coded medication management (12.6% vs 11%⁸ vs 7.2%¹²), although it is unclear if this represents a normal progression with time or if Florida is progressing faster than other states. Lastly, our study suggests that surveying CIOs regarding pharmacy-related IT may yield comparable results to similar surveys of pharmacy directors. This congruency is important, because in many organizations the CIO may make the final strategic decision regarding IT that can affect the pharmacy department.

The design of our study contains several limitations typically consistent with survey research. This includes individuals' willingness to respond to questions truthfully and the potential for respondent bias. In addition, the survey used targeted CIOs and not pharmacy managers; a limitation is acknowledged in that survey questions were not optimally designed to capture pharmacy specific usage of some technologies (eg, PDAs). Lastly, our sample included only

community hospitals in the state of Florida. As such, the results should be generalized with caution to other areas where market, regulatory, and professional forces may be different.

CONCLUSION

Our study indicates that Florida hospitals have similar adoption characteristics of pharmacy-related IT when compared to other nationwide studies. However, in Florida and overall, IT utilization in health care continues at a slow pace. This is troubling given the existence of evidence suggesting that IT can reduce medication errors and improve patient outcomes. To improve adoption of patient safety IT, pharmacists should play an active role in collaborating with hospital leaders to consider implementing these technologies at their facilities.

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