

# Technology

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The technology section was introduced to the Hospital Pharmacy in Canada Survey in 2003/04, at a time when public and government expectations of the healthcare system were beginning to focus on several major areas of concern. These included patient safety, timely access to needed care, greater efficiency in delivering healthcare, system accountability, and optimization of outcomes. These issues continue to be the focus of many efforts to improve Canada's healthcare system. Healthcare managers, including those responsible for pharmacy services, recognize that the key to addressing these issues lies in the appropriate use of technology. Fortunately, medication systems technology has progressed significantly in the past decade, and its cost-effectiveness has reached the point where many hospitals can now justify the acquisition of these technologies. Pharmacy information systems, combined with automation technologies, offer substantial opportunities for improving the safety and efficiency of the medication system, and hospital pharmacy is now poised on the cusp of a major technological change. The current survey results indicate that hospitals are only slowly beginning to embrace this change.

### Pharmacy Information Systems - Clinical Decision Support

The 2005/06 survey included a number of new questions that were intended to provide a more comprehensive picture of the types of clinical decision support functionality that are built into the pharmacy information systems used in Canadian hospitals. Consequently, it was possible to compare some, but not all, of the 2005/06 survey results with those from the 2003/04 survey. Even those comparisons that are made between the 2005/06 and the 2003/04 survey results must be interpreted cautiously, since the number of respondents to this part of the survey increased significantly in 2005/06 (from 57 respondents in 2003/04 to 118 respondents in 2005/06). We provided a definition of what constituted a "clinical decision support system" in the 2005/06 survey, and this may have helped to improve the response rate for the questions in this section of the survey.

- Eighty-three percent of respondents reported that their pharmacy information system had clinical decision support functionality in 2005/06, compared with 40% in 2003/04. (Table H-1) However, as noted above, we provided a definition of a "clinical decision support system" in the 2005/06 survey, and this may have affected the response rate for this question.

Of those respondents with clinical decision support functionality as a part of their pharmacy information system:

- Ninety-nine percent of respondents reported that drug allergy alerts were part of the decision support functionality that was available in the pharmacy information system, and 95% of those who had the option to use drug allergy alerts were using that functionality. The results were similar in all geographical areas except the Prairies, where only 80% reported use of the drug allergy functionality, compared to 94-100% of the respondents in other regions of the country.
- Ninety-seven percent of respondents reported that drug interaction alerts were part of the functionality available to them, and 97% of those who had the option to use drug interaction alerts were doing so. Again, the results were similar for all regions of the country, with the exception of the Prairies, where a smaller percentage of respondents (80%) reported that the functionality was in use.
- Despite the 59% to 69% of respondents who reported that the functionality for computer generated maximum dose alerts was available to them, only 21-31% of those respondents with the functionality reported that they were using it in their departments for adult drug orders, pediatric/neonatal drug orders, oncology drug orders, or other types of drug orders (Table H-1).
- The percentage of teaching hospitals that reported using maximum dosage alerts for adults, oncology drugs, and other drugs was approximately twice that of non-teaching hospitals. In contrast pediatric/neonatal maximum dose alerts were reported as being used by 28% of non-teaching hospitals, compared to only 18% of teaching hospitals who were using that functionality.

- Forty-six percent of respondents reported that the functionality to provide dosage modification alerts for patients with renal dysfunction was available to them and 59% of those respondents reported that it was in use. Dosage modification alert functionality for patients with hepatic dysfunction was reported to be available by 33% of respondents, but only 28% of those were actually using that functionality.

These results raise the question of why available patient-safety functionality is frequently not being used by hospitals across the country, particularly following the awareness created by the Institute of Medicine's "To Err is Human" report<sup>1</sup> and The Canadian Adverse Event study.<sup>2</sup>

**Table H-1 Pharmacy Information Systems – Clinical Decision Support 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
Hospitals (n=)	(142)	(27)	(78)	(37)	(37)	(105)
<b>Pharmacy Information System includes a clinical decision support system</b>	118 83%	24 89%	65 83%	29 78%	27 73%	91 87%
<b>Types of Clinical Decision Support Functionality</b>	<b>(118)</b>	<b>(24)</b>	<b>(65)</b>	<b>(29)</b>	<b>(27)</b>	<b>(91)</b>
Drug allergy alerts -- available	117 99%	23 96%	65 100%	29 100%	27 100%	90 99%
Drug allergy alerts -- in use	111 95%	22 96%	61 94%	28 97%	26 96%	85 94%
Drug interaction alerts -- available	115 97%	22 92%	64 98%	29 100%	27 100%	88 97%
Drug interaction alerts -- in use	111 97%	22 100%	61 95%	28 97%	27 100%	84 95%
Maximum dose alerts for adults -- available	82 69%	16 67%	44 68%	22 76%	21 78%	61 67%
Maximum dose alerts for adults -- in use	22 27%	5 31%	11 25%	6 27%	9 43%	13 21%
Maximum dose alerts for pediatrics / neonates -- available	71 60%	13 54%	37 57%	21 72%	17 63%	54 59%
Maximum dose alerts for pediatrics / neonates -- in use	18 25%	3 23%	9 24%	6 29%	3 18%	15 28%
Maximum dose alerts for cytotoxic oncology drugs -- available	73 62%	13 54%	39 60%	21 72%	20 74%	53 58%
Maximum dose alerts for cytotoxic oncology drugs -- in use	15 21%	4 31%	6 15%	5 24%	7 35%	8 15%
Maximum dose alerts for other selected drugs -- available	70 59%	13 54%	36 55%	21 72%	15 56%	55 60%
Maximum dose alerts for other selected drugs -- in use	22 31%	4 31%	7 19%	11 52%	7 47%	15 27%
Dosage modification alerts for patients with renal dysfunction -- available	54 46%	7 29%	31 48%	16 55%	7 26%	47 52%
Dosage modification alerts for patients with renal dysfunction -- in use	32 59%	6 86%	16 52%	10 63%	5 71%	27 57%
Dosage modification alerts for patients with hepatic dysfunction -- available	39 33%	7 29%	20 31%	12 41%	5 19%	34 37%
Dosage modification alerts for patients with hepatic dysfunction -- in use	11 28%	5 71%	3 15%	3 25%	2 40%	9 26%
Drug therapy guidance, using evidence-based guidelines -- available	21 18%	2 8%	12 18%	7 24%	3 11%	18 20%
Drug therapy guidance using evidence-based guidelines -- in use	12 57%	1 50%	6 50%	5 71%	3 100%	9 50%
Ability to input patient-specific variables used to assess drug therapy and dosing -- available	58 49%	7 29%	33 51%	18 62%	9 33%	49 54%
Ability to input patient-specific variables used to assess drug therapy and dosing-- in use	46 79%	5 71%	24 73%	17 94%	8 89%	38 78%

- The majority of hospitals, (82%), reported that their pharmacy information system did not have evidence-based guidelines or clinical pathways integrated into its clinical decision support systems. Of the 18% of respondents that reported having this functionality, only 57% reported that the functionality was being used.
- The ability to input patient specific variables that are then used to calculate patient-specific dosages, or are used to enable the provision of patient-specific clinical recommendations, was reported to be available by 49% of respondents, and 79% of those reported using it.

There appears to be a gap in the ability of facilities to integrate evidence-based guidelines into the electronic systems that pharmacists are, or should be, using to help them make decisions about the appropriateness of prescribed drug therapy.

### **Pharmacist Access to Laboratory Test Results**

The pharmacist's ability to assess the appropriateness of many medication orders depends to a great extent on the pharmacist's ability to easily retrieve relevant test results. Those results are often needed in order to assess the appropriateness of the medication, and the medication dosage, that have been ordered for the patient.

Unfortunately, pharmacists often find themselves working in areas where they do not have ready access to the patient's chart. Electronic health records, (EHRs), available electronically to the pharmacist at the point in time when they are reviewing medication orders, are the preferred solution to this problem. However, few hospitals in Canada have yet implemented EHRs and the best option for providing pharmacist access to laboratory results lies in the creation of a seamless interface between the lab and pharmacy systems. Though less efficient for pharmacists to use, view-only access to laboratory values on all pharmacy computer terminals is an alternative for facilities that cannot implement an interface between the lab and pharmacy systems.

- There was only a modest increase in the percentage of respondents who reported having an interface between the lab system and the medication order entry system, (34% in 2005/06 compared to 25% in 2003/04).
- Similarly, survey respondents reported only a slight increase in view-only access to lab test results, (63% in 2005/06 versus 59% in 2003/04).
- However, it was encouraging to note that only three respondents, (2%), reported that access to lab test values was still paper based. (Table H-2).
- British Columbia, Ontario and Atlantic Canada were more likely to report lab systems interfaced with medication order entry systems.

For future surveys, an interesting follow-up to these results might be to ask respondents if they have a pharmacy information system that is part of an integrated, corporate-wide system or if it is a stand-alone "best of breed" pharmacy information system. It would be helpful to know if there is any difference in how lab data is accessed within hospitals that have opted for the integrated or "best of breed" approaches to pharmacy information systems.

**Table H-2 Pharmacist Access to Laboratory Test Results 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
<b>Hospitals (n=)</b>	(142)	(27)	(78)	(37)	(37)	(105)
<b>Pharmacists are provided with access to laboratory test results through</b>						
Paper-based medical record only	3 2%	3 11%	0 0%	0 0%	0 0%	3 3%
View-only access available from pharmacy terminals	90 63%	14 52%	53 68%	23 62%	27 73%	63 60%
Lab system interfaced with medication order entry system	48 34%	9 33%	25 32%	14 38%	10 27%	38 36%

### Computerized Prescriber Order Entry Systems (CPOE)

- The number of respondents, (eight respondents), that reported an operational CPOE system is essentially unchanged compared to the 2003/04 survey results, (seven respondents). There has been a slight increase in the percentage of respondents that reported an approved plan to implement CPOE in 2005/06, (23% , 33/142), compared to the 2003/04 survey, (18% , 26/144)
- Teaching hospitals and hospitals with more than 500 beds were again most likely to report a functional CPOE system, or an approved plan to implement one. (Table H-3).

The number of respondents reporting that a CPOE system has been implemented at their facility has remained fairly static over the last few years. The presence of an approved plan to implement CPOE that was reported by 26 facilities in 2003/04 did not seem to lead to implementation of CPOE in almost any of those facilities within the two year period between the 2003/04 and 2005/06 surveys. Several factors may have contributed to this, including the large financial and human resource investment that is actually required to implement CPOE systems. It is also possible that the maturity of the available technology, the ability to effectively meet user needs, and/or the ability of organizations to effectively reorganize and integrate the new clinical and organizational workflows may have delayed CPOE implementation.

Although some published studies indicate that CPOE systems reduce medication errors,<sup>3</sup> other studies report increased medication risks associated with a CPOE implementation. One such study by Koppel et al reports 22 different medication error risks that could be introduced by CPOE implementation within a typical hospital environment.<sup>4</sup>

- Of the eight respondents that reported using a functional CPOE system, four reported a unidirectional or bi-directional interface with the pharmacy information system, while the remaining four respondents reported that there was no interface between their CPOE and pharmacy information systems. This represents little change in the number of respondents who reported that there was an interface between the two systems in 2003/04.
- Five of eight respondents that reported having a CPOE system were from Ontario, with only one having an interface to the pharmacy information system. This presents an interesting observation as to the value gained, compared with the opportunities missed, by implementing a non-interfaced prescriber order entry system.

- There was an increase in the number of respondents in the 2005/06 survey who reported that their CPOE system includes clinical decision support functionality (6/8 respondents in 2005/06, compared to 1/7 in 2003/04). This functionality was reported to include prescriber alerts for unsafe orders, (6/8 respondents in 2005/06 compared to 3/7 in 2003/04), and guidance related to formulary drug use, (7/8 respondents in 2005/06, compared to 4/7 in 2003/04.)

The implementation of clinical decision support systems presents an interesting opportunity for pharmacist involvement in the selection, development and ongoing maintenance of CPOE systems, particularly considering the reports of increased medication error risks associated with CPOE implementations and its associated organizational workflow changes.<sup>3 4 5 6</sup>

- Pharmacist verification of orders entered by prescribers, prior to the dispensing of medications from the pharmacy, was reported to be a requirement by all respondents with CPOE systems in both 2003/04 (7/7) and in 2005/06 (8/8).
- There was little change in the small number of respondents that reported pharmacist verification of CPOE orders was necessary prior to the drug appearing on the nursing medication administration record, the drug becoming accessible from decentralized automated medication cabinets, or the drug becoming accessible from ward stock, as compared to the 2003/04 survey. (Table H-3)

The implementation of CPOE does not reduce the need for pharmacist verification of medication orders or reduce the need for robust pharmacy information systems with integrated decision support to support the pharmacist's medication order review. Some unpublished surveys suggest that only 50 to 60% of medication orders are actually entered into CPOE systems by the prescriber, which further emphasizes the need for pharmacists to perform a final review of medication orders before they become activated.

**Table H-3 Computerized Prescriber Order Entry 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
Hospitals (n=)	(142)	(27)	(78)	(37)	(37)	(105)
<b>Computerized prescriber order entry (CPOE)</b>						
Operational	8 6%	1 4%	3 4%	4 11%	4 11%	4 4%
Approved plan to implement	33 23%	7 26%	18 23%	8 22%	13 35%	20 19%
No CPOE plan approved	100 70%	18 67%	57 73%	25 68%	20 54%	80 76%
<b>CPOE/Pharmacy Information System (PIS) Integration</b>	(8)	(1)	(3)	(4)	(4)	(4)
CPOE is interfaced to PIS (unidirectional)	2 25%	1 100%	1 33%	0 0%	1 25%	1 25%
CPOE is interfaced to PIS (bidirectional)	2 25%	0 0%	1 33%	1 25%	1 25%	1 25%
Medication orders are re-entered into the Pharmacy system	4 50%	0 0%	1 33%	3 75%	2 50%	2 50%
<b>Clinical Decision Support for CPOE</b>						
Is integrated with a clinical decision support system	6 75%	0 0%	2 67%	4 100%	3 75%	3 75%
Is interfaced with the lab system to alert practitioners	3 38%	0 0%	2 67%	1 25%	1 25%	2 50%
Alerts prescribers to unsafe orders during order entry	6 75%	1 100%	2 67%	3 75%	2 50%	4 100%
Guides the use of formulary drugs	7 88%	1 100%	3 100%	3 75%	3 75%	4 100%
Guides the use of weight-based or surface area based dosing	6 75%	0 0%	3 100%	3 75%	3 75%	3 75%
Guides the dosing in special populations	5 63%	0 0%	3 100%	2 50%	2 50%	3 75%
<b>Pharmacists verify CPOE orders before</b>						
Dispensing medications from the central or satellite pharmacy	8 100%	1 100%	3 100%	4 100%	4 100%	4 100%
Medications are accessed from decentralized automated cabinets	1 13%	0 0%	0 0%	1 25%	1 25%	0 0%
Ward stock medications are accessed	1 13%	0 0%	1 33%	0 0%	1 25%	0 0%
Medications are entered on the Medication Administration Record (MAR)	3 38%	0 0%	0 0%	3 75%	1 25%	2 50%

## Wireless Networks

Hospitals appear to be embracing the use of wireless networks for the enhancement of patient care, as well as for their potential to increase organizational efficiency and effectiveness.

- Twenty-six percent of respondents reported that an operational wireless network was in place at their facility. Percentages reported were similar for teaching hospitals, non-teaching hospitals, hospitals of all bed sizes, and hospitals with all drug distribution models. (Table H-4)
- Ontario respondents reported a higher availability of operable wireless networks, at 53% of respondents, (24/45), than did other regions. Atlantic Canada reported 33% availability, (5/15), and other provinces reported approximately 10% availability of wireless networks.
- Of the 37 respondents that reported the availability of a wireless network, 38% reported that pharmacists use portable devices to access the wireless network. Interestingly, the smaller non-teaching institutions reported almost double the percentage use of wireless networks by pharmacy than the large (more than 500 bed) and/or teaching hospitals.
- The Prairies were the only region that reported no use by pharmacy of portable devices to access the wireless network.
- The most commonly reported reason for accessing the wireless network by pharmacy was for accessing drug information databases, (93%, 13/14). (Table H-4). Using the wireless network to access drug profiles and health records was reported by nine of 14 respondents and using the wireless network for decentralized order entry by pharmacists was reported by six of 14 respondents.

**Table H-4 Wireless Network Systems 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
<b>Hospitals (n=)</b>	(142)	(27)	(78)	(37)	(37)	(105)
<b>Wireless system installed and operable</b>	37 26%	9 33%	19 24%	9 24%	9 24%	28 27%
<b>To access wireless network, pharmacy uses portable computers or handheld devices</b>	(37) 14 38%	(9) 3 33%	(19) 9 47%	(9) 2 22%	(9) 2 22%	(28) 12 43%
<b>Wireless network is accessed by pharmacy for .....</b>	(14)	(3)	(9)	(2)	(2)	(12)
Decentralized order entry on patient care units	6 43%	1 33%	3 33%	2 100%	1 50%	5 42%
Access to patient drug profiles from the Pharmacy Information System (PIS)	9 64%	1 33%	6 67%	2 100%	1 50%	8 67%
Access to electronic health records	9 64%	1 33%	6 67%	2 100%	1 50%	8 67%
Access to drug information databases	13 93%	3 100%	8 89%	2 100%	2 100%	11 92%

## Handheld Devices

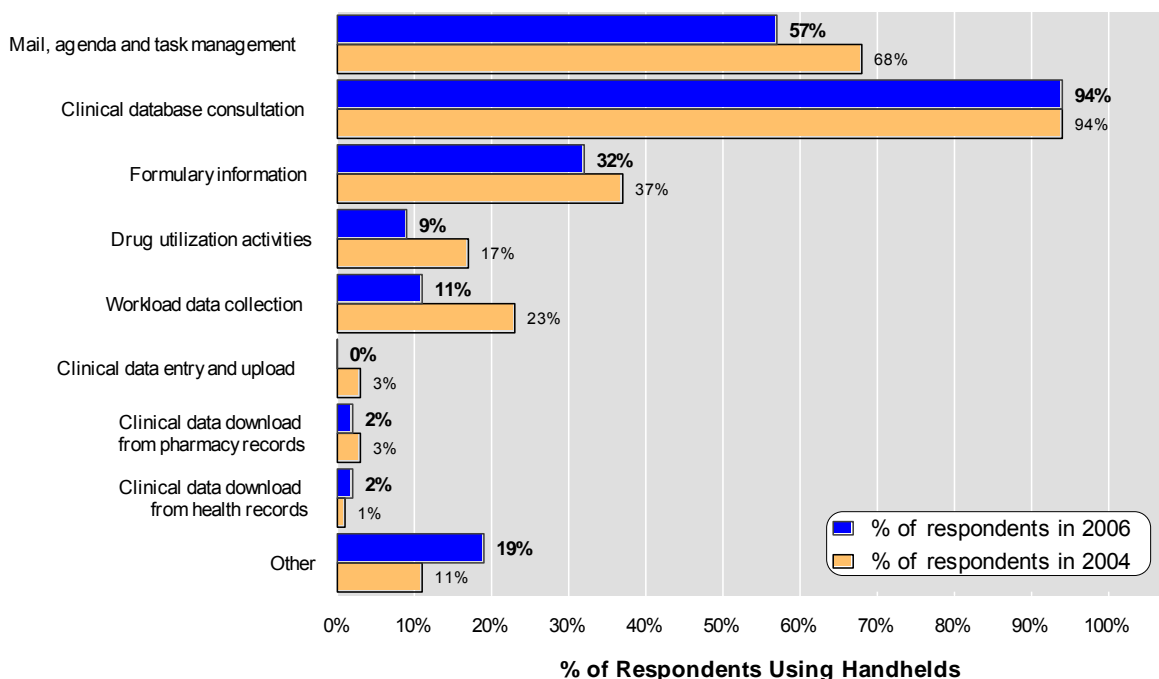
- Eighty percent of the 142 respondents reported use of handheld devices by pharmacy.
- Since the 2003/04 report, the reported use of handheld devices by pharmacy has remained the same for clinical database consultation, (94%). The use of handhelds for clinical data download from computerized pharmacy or health records remains unchanged, at just 2 respondents. (Figure H-1)
- The reported use of handheld devices for mail, agenda, and task management was 57% in 2005/06, a bit lower than the 68% who reported the use of handhelds for this purpose in 2003/04.
- The reported use of handheld devices for access to formulary information was similar to that in the previous survey, (32% in 2005/06, compared to 37% in 2003/04).
- The reported use of handheld devices for workload data collection, (11% in 2005/06, compared to 23% in 2003/04), and drug utilization, (9% in 2005/06, compared to 17% in 2003/04), was lower than that reported in the previous survey.

**Table H-5 Hand Held Devices 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
<b>Hospitals (n=)</b>	(142)	(27)	(78)	(37)	(37)	(105)
<b>Handheld devices are used in department</b>	113 80%	21 78%	61 78%	31 84%	34 92%	79 75%
<b>Handheld devices are used for .....</b>	(113)	(21)	(61)	(31)	(34)	(79)
Clinical data download from computerized pharmacy records	2 2%	0 0%	2 3%	0 0%	0 0%	2 3%
Clinical data download from computerized health records	2 2%	0 0%	1 2%	1 3%	0 0%	2 3%
Clinical database consultation (Micromedex, Lexicomp)	107 94%	19 90%	57 93%	31 97%	33 94%	74 94%
Drug utilization activities	10 9%	2 10%	4 7%	4 13%	4 11%	6 8%
Formulary information	36 32%	5 24%	24 39%	7 23%	10 29%	26 33%
Workload data collection	13 11%	0 0%	7 11%	6 19%	4 11%	9 11%
Mail, agenda and task management (Outlook, Lotus Notes)	64 57%	15 71%	26 43%	23 74%	25 74%	39 49%
Other	21 19%	1 5%	12 20%	8 26%	9 26%	12 15%



**Figure H-1 Functions for which handheld devices are used**



**Base: Respondents reporting the use of handheld devices (71 in 2004, 113 in 2006)**

## Bar Coding

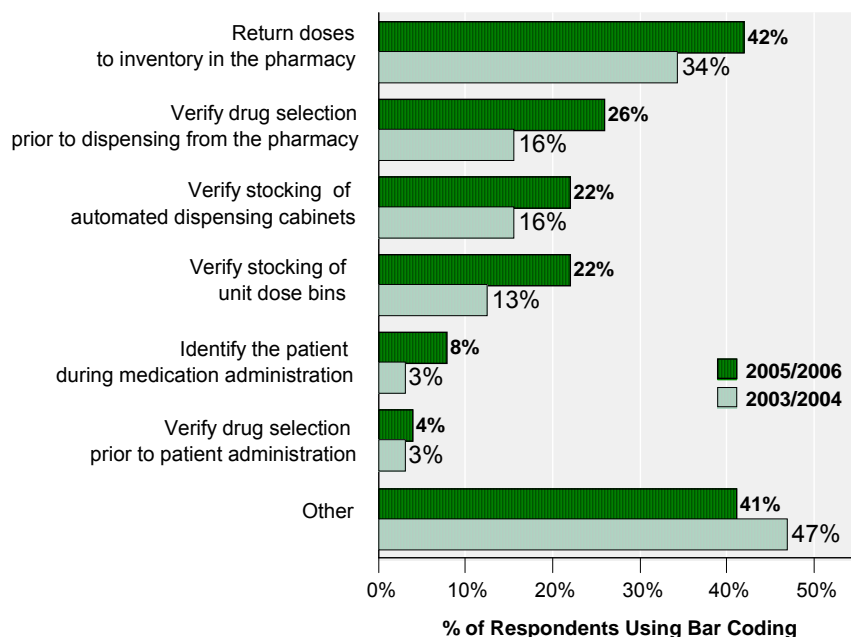
The focus on patient safety within the healthcare system has continued since the last survey and there has been a corresponding interest in the adoption of technology, such as bar coding, as a means of improving the safety of patient care.

- The current survey results indicate an increase in the number and percentage of hospitals adopting bar code technology in the medication system, continuing the trend of past surveys (50/142 or 35% in 2005/06 versus 32/144 or 22% in 2003/04).
- Increased usage of bar coding occurred in the following areas: drug selection prior to dispensing from pharmacy (26% in 2005/06, compared to 16% in 2003/04); returning doses to pharmacy inventory (42% in 2005/06, compared to 34% in 2003/04); verifying unit dose stocking (22% in 2005/06, compared to 13% in 2003/04); and verifying the stocking of automated dispensing cabinets (22% in 2005/06, compared to 16% in 2003/04). (Figure H-2)
- The reported use of bar coding in teaching hospitals and hospitals with more than 200 beds was greater than in non-teaching facilities or hospitals with 100 to 200 beds.

**Table H-6 Bar Coding 2005/06**

	All	Bed Size			Teaching Status	
		100- 200	201- 500	>500	Teaching	Non-Teaching
<b>Hospitals (n=)</b>	(142)	(27)	(78)	(37)	(37)	(105)
<b>Bar Coding is used in the Medication System</b>	50 35%	3 11%	29 37%	18 49%	19 51%	31 30%
<b>Bar Coding is used in the Medication System to</b>	(50)	(3)	(29)	(18)	(19)	(31)
Verify drug selection prior to dispensing from the pharmacy	13 26%	1 33%	7 24%	5 28%	5 26%	8 26%
Verify drug selection prior to patient administration	2 4%	0 0%	2 7%	0 0%	0 0%	2 6%
Identify the patient during medication administration	4 8%	1 33%	2 7%	1 6%	0 0%	4 13%
Return doses to inventory in the pharmacy	21 42%	1 33%	14 48%	6 33%	8 42%	13 42%
Verify stocking of unit dose bins	11 22%	0 0%	6 21%	5 28%	4 21%	7 23%
Verify stocking of automated dispensing cabinets	11 22%	0 0%	8 28%	3 17%	5 26%	6 19%
Other	21 41%	2 67%	11 37%	8 44%	7 37%	14 44%

**Figure H-2 Uses of Bar Coding**



*Base: Respondents reporting use of bar coding in medication system (32 in 2004, 50 in 2006)*

It is well understood and reported in the literature that a large percentage of medication errors, estimated at 34% of all medication errors<sup>7,8</sup>, occur at the bedside during administration. Bedside bar code verification systems are significantly more successful at reducing these incidences than currently used practices. Despite this evidence, the adoption of bedside barcode verification systems in Canada has been very slow.

- Only 8% (4/50) of the 50 respondents that reported using bar code technology reported they used point-of-care bar code systems to identify the patient during the medication administration process. This is only a small change from the single respondent in 2003/04 that reported the use of point-of-care bar code verification systems.
- Two respondents reported that they verified the drug selection, using bar code technology, prior to administration to the patient, compared to one respondent who reported doing so in 2003/04.

## Conclusion

The slow progress in the implementation and utilization of advanced medication systems technology is perhaps indicative of the challenges facing organizations as they strive to move forward in very challenging times. The introduction of technology is complex and the implications are far-reaching. Many systems and processes are inter-related, interdependent, and reliant on good implementation processes to achieve their full potential. However, the potential patient safety gains are significant and all healthcare managers, including hospital pharmacy managers, should strive for a healthcare system which takes full advantage of the opportunities that technology offers.

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