Technology

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Canadian healthcare continues to change at a rapid pace, and demand for professionals continues to increase beyond supply. Pressures are increasing, both from Ministries of Health and the public, for improved safety and efficiency within the healthcare system. The recent Canadian Adverse Events Study [(1)] confirmed previous reports that there are opportunities to enhance patient safety throughout the healthcare system. Judicious application of new technologies is reported as one of the strategies to optimize patient care and improve outcomes, communication and efficiency.

Significant advances in the availability and accessibility of technology for medication systems have occurred in recent years. In order to collect information on the adoption of such systems, the technology section was introduced into the current survey. While some parameters do have a comparator for the previous survey, others are new, and will provide baseline data that may be useful for individual organizations or future comparisons.

Pharmacy Information System Integrated with Clinical Decision Support

The availability of timely and appropriate information for caregivers at the moment of decision-making is important for the achievement of best practice, and plays a significant role in patient safety. Clinical decision support systems are rules-based systems, which are designed to help guide appropriate prescribing, based on evidence. Rules need to be appropriately triggered by clinically significant data. Interventions at the time of ordering can include such factors as allergies, lab values, and interactions. Orders can be reviewed retrospectively for compliance with guidelines or for quality assurance.

- Forty percent of all respondents reported operating pharmacy systems integrated with decision support (Table H-1). Of the 57 respondents with integrated PIS and clinical decision support systems, 68% (39/57), were from non-teaching institutions and 32%, (18/57) were from organizations with 200 or fewer beds. The adoption of integrated pharmacy information systems and clinical decision support was reported more commonly by respondents from Ontario (58%, 26/45), and the Atlantic region,(61%, 11/18), and less commonly in Quebec, (21%, 10/48).

Pharmacy Information System, (PIS), uses Max Dose Alerts automatically

- The ability of a computer system to provide maximum dose alerts is an important patient safety tool. Twenty-eight percent of respondents reported automatic maximum dose alerts via the PIS, compared with 24% in 2001/02. Teaching hospitals were more likely than non- teaching hospitals to report use of maximum dose alerts, (38% of teaching hospital respondents, 23% non-teaching). The reported use of maximum dose alerts was highest in Ontario (38%, 17/45) and British Columbia, (33%, 4/12) and lowest in Quebec, (21%, 10/48).

- Among respondents who reported that the Pharmacy computer system issues maximum dose alerts, 61% indicated the alerts were used for specific drugs, 54% for adults, 51% for pediatrics and 39% for neonates. Use of maximum dose alerts for oncology, a high-risk class, was reported by 37% of these respondents, while use for selective drug types was reported by only 7%.

Access to Lab Test Values

In order for pharmacists to apply clinical decision making to optimize patient therapy, access is required to the appropriate tools and information at the time of order entry. Access to lab data is essential to this task.

- More than half of the respondents, (59%) reported access to view-only information from pharmacy terminals. A quarter of respondents, (25%) reported access to a fully interfaced lab and medication order entry system. Fifteen percent of respondents reported using a paper-based system only, to access lab values, which limits the ability to provide efficient, timely clinical intervention.

- Smaller hospitals, (100-200 beds) were least likely to report view-only access and were also less likely to report full interfaces with lab systems, resulting in a higher reliance on a paper based medical record for access to lab data.

- Lab systems interfaced with the medication order system were reported more often in the Atlantic region (50%, 9/18) and British Columbia (42%, 5/12) than in Ontario (33% 15/45), Quebec (10%, 5/48). and the Prairies, (10%, 2/21).

Table H-1. Pharmacy Information Systems 2003/04

		Bed Size			Teaching Status	
Hospitals (n=)	**All (144)**	**100-200 (38)**	**201-500 (68)**	**>500 (38)**	**Yes (56)**	**No (88)**
Pharmacy information system (PIS) integrated with a clinical decision support system	57 40%	18 47%	23 34%	16 42%	18 32%	39 44%
Pharmacy computer System issues maximum dose alerts automatically upon order entry (n= 41)	41 28%	10 26%	21 31%	10 26%	21 38%	20 23%
Adults	22 54%	6 60%	11 52%	5 50%	10 48%	12 60%
Paediatrics	21 51%	7 70%	11 52%	3 30%	9 43%	12 60%
Neonates	16 39%	5 50%	6 29%	5 50%	9 43%	7 35%
Oncology	15 37%	4 40%	5 24%	6 60%	9 43%	6 30%
Selective drugs	25 61%	5 50%	15 71%	5 50%	10 48%	15 75%
Selective drug types	3 7%	1 10%	1 5%	1 10%	2 10%	1 5%
Pharmacists are provided with access to laboratory test values through:						
Paper based medical record only	22 15%	14 37%	7 10%	1 3%	4 7%	18 20%
View only access from pharmacy terminals	85 59%	17 45%	40 59%	28 74%	41 73%	44 50%
Lab system fully interfaced	36 25%	7 18%	20 29%	9 24%	11 20%	25 28%

Computerized Physician Order Entry, (CPOE)

- Computerized physician order entry systems have been reported to reduce the incidence of serious medication error related to transcribing or interpretation of handwritten orders by 55%. [1] [2] However, only 5% of respondents (Table H-2) reported an operational CPOE system compared with 7% in the 2001/02 report. A further 18% reported an approved plan to implement, an increase of 4% over 2001/02.

- The survey indicated that hospitals with 500 or fewer beds and those with non-teaching status were least likely to have an operational CPOE system or approved implementation plan, perhaps an indication of the considerable resource burden to the organization for implementing such programs

- Regionally, 24-33% of hospitals in the Prairies, Ontario and Atlantic provinces reported having an approved plan to implement CPOE. Respondents from British Columbia and Quebec reported approved plans for implementation of CPOE less frequently. Ninety-two percent of hospitals in both British Columbia and Quebec reported they did not have a functional CPOE, and had no approved plan to implement within the next five years.

CPOE/pharmacy information system integration

- Of the seven respondents with CPOE, all of which were in the large teaching category, five reported medication orders are re-entered into the pharmacy system. Only two respondents reported operating CPOE systems interfaced with the PIS (one from Ontario and one from the Atlantic region).

Clinical Decision Support

- There was little change in the reported use of clinical decision support for CPOE since the 2001/02 survey. Of the seven respondents with CPOE, four reported CPOE is used to guide the use of formulary drugs, established protocols and clinical pathways. Three respondents reported using CPOE to alert the prescriber to unsafe orders during order entry. Only two respondents indicated the CPOE system was interfaced with the lab system to alert practitioners (Ontario, British Columbia), and only one respondent reported using clinical decision support (Ontario).

Pharmacist Verification of CPOE Orders

- Although all seven respondents with CPOE reported pharmacist verification before medications are dispensed from a central or satellite pharmacy, only one respondent reported that verification occurred before medications appear on the MAR or drugs are accessed from automated cabinets. This brings to attention both the practical challenges of timely drug supply and the need for enhanced systems of patient safety.

Table H-2. Computerized Physician Order Entry 2003/04

		Bed Size			Teaching Status	
Hospitals (n=)	All (144)	100-200 (38)	201-500 (68)	>500 (38)	Yes (56)	No (88)
Computerized physician order entry (CPOE) is						
Operational	7 5%	1 3%	1 1%	5 13%	6 11%	1 1%
Approved plan to implement	26 18%	6 16%	10 15%	10 26%	14 25%	12 14%
No CPOE plan approved	110 76%	31 82%	56 82%	23 61%	36 64%	74 84%
CPOE/PIS Integration (n=7)						
Integrated with Clinical decision support system	1	0	0	1	1	0
Interfaced to PIS (unidirectional)	1	0	0	1	1	0
Interfaced to PIS (bidirectional)	1	0	0	1	1	0
Medication orders are re-entered into the PIS	5	1	1	3	4	1
Clinical Decision Support for CPOE (n=7)						
Integrated CPOE/clinical decision support	1	0	0	1	1	0
Lab system interface	2	0	0	2	2	0
Prescribers alerted to unsafe orders	3	0	1	2	3	0
Guides use of formulary drugs	4	0	1	3	4	0
Guides use of protocols/pathways	4	0	1	3	4	0
Pharmacists verify CPOE orders before (n=7)						
Dispensing drugs from central or satellite pharmacy	7	1	1	5	6	1
Drugs are accessed from decentralized automated cabinets	1	0	0	1	1	0
Medications appear on MAR	1	0	0	1	0	1
Floor stock medications are accessed	-	-	-	-	-	-

Physician/Professional use of Handheld Devices

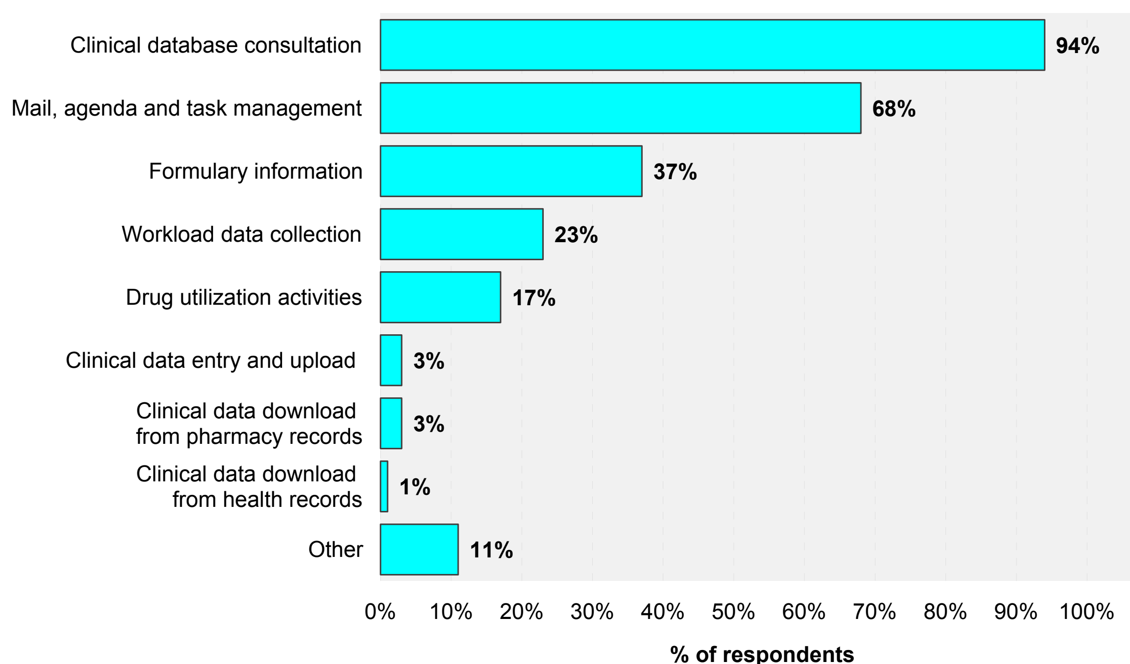
- Almost half of all respondents, (49%) reported the use of institution supplied handheld devices by professional staff and physicians (Table H-3). Of the respondents reporting use of handheld technology for clinical activities, 96% reported use by pharmacists, 42% by physicians and 3% by nurses. This indicated a significant increase since the 2001/02 survey, where only 52% of pharmacists reported using handheld devices. As the current survey specified institution-supplied device whereas the 2001/02 survey did not, the results are not directly comparable.

Wireless operable for med system

- Wireless networks are now a reality for healthcare systems. The available applications are growing in number, including medication, laboratory and documentation systems. The opportunity exists to optimize patient care through the application of this technology. Wireless systems are operated on a real time basis, enhancing the safety, convenience and accuracy of healthcare processes. Data is available to all healthcare providers simultaneously and throughout the organization. Wireless networks can be applied to provide usable data to drive best practices, risk assessment and other quality initiatives.

- Only 8%, (6/71) of respondents from institutions where hand held devices are used reported using an installed and operable wireless network for medication systems. Of the six respondents, five were non-teaching hospitals in the 201-500 bed category. Four of the six respondents were from Ontario.

Figure H-1 Functions for which handheld devices are used



Base: Respondents reporting the use of handheld devices (71)

- The majority of respondents reporting use of institution-supplied handheld devices indicated they use them for clinical database consultation (94%), (Figure H-1). The next most common use was for mail, agenda and task management (68%). Other commonly reported uses included formulary information (37%) and workload data collection (23%). Though a notable 17% of respondents reported using handheld technology for drug utilization, most of this activity is concentrated within the Quebec and Atlantic regions.

Table H-3 Hand Held Devices 2003/04

		Bed Size			Teaching Status	
Hospitals (n=)	All (144)	100-200 (38)	201-500 (68)	>500 (38)	Yes (56)	No (88)
Physicians and/or other professionals use institution-supplied **hand held devices** for clinical activities	71	12	35	24	34	37
	49%	32%	51%	63%	61%	42%
Handhelds used by (n=71)						
Pharmacists	96%	92%	94%	100%	100%	92%
Physicians	42%	42%	46%	38%	35%	49%
Nurses	3%	8%		4%	3%	3%
Others	4%	8%		8%	6%	3%
Wireless system installed and operable and used for medication use system	6	-	5	1	1	5
Functions for which handheld devices are used (n=71)						
Clinical database consultation	94%	92%	94%	96%	100%	89%
	(67)	(11)	(33)	(23)	(34)	(33)
Mail agenda and task management	68%	75%	60%	75%	71%	65%
	(48)	(9)	(21)	(18)	(24)	(24)
Drug Utilization Activities	17%	17%	17%	17%	24%	11%
	(12)	(2)	(6)	(4)	(8)	(4)
Formulary information	37%	42%	34%	38%	32%	41%
	(26)	(5)	(12)	(9)	(11)	(15)
Workload data collection	23%	33%	17%	25%	24%	22%
	(16)	(4)	(6)	(6)	(8)	(8)
Clinical data entry and upload to main pharmacy software	3%	8%	-	4%	-	5%
	(2)	(1)	-	(1)	-	(2)
Clinical data download from computerized pharmacy records	3%	-	3%	4%	3%	3%
	(2)	-	(1)	(1)	(1)	(1)
Clinical data download from computerized health records	1%	-	3%	-	3%	-
	(1)	-	(1)	-	(1)	-
Other	11%	-	14%	13%	18%	5%
	(8)	-	(5)	(3)	(6)	(2)

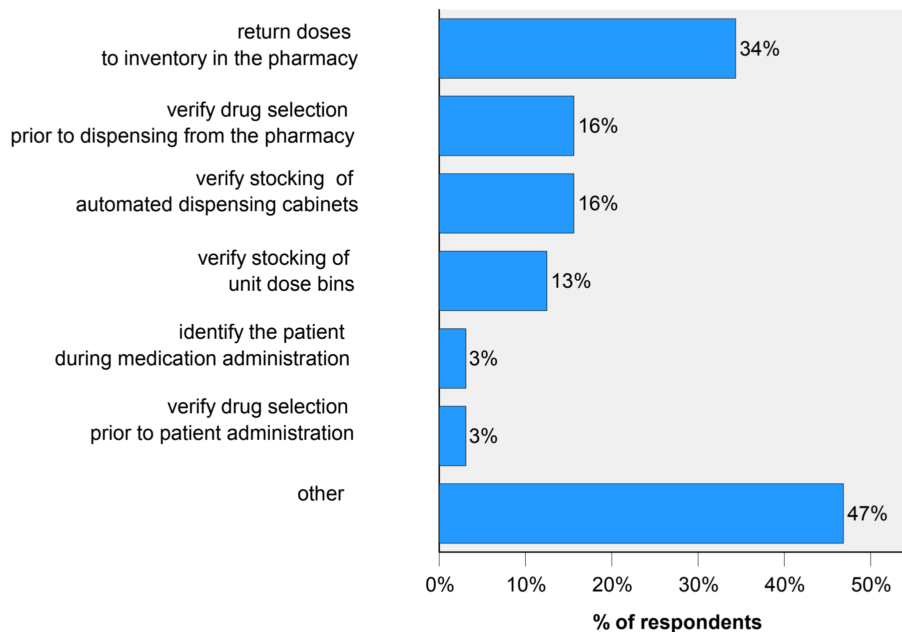
Bar Code used in Med System

The focus on safety of hospital systems has been growing over recent years. Hospitals are striving to respond to the concerns identified by adverse events studies [1] and by consumers regarding safety of the medical system. Bar code technology may present an opportunity to enhance the safety of medication systems. In May of 2004, the FDA, as a commitment to reduce preventable medication errors in US hospitals and to encourage hospitals to adopt advanced technology systems, mandated that manufacturers must include bar codes on all new drugs. This mandate for the US is effective immediately for all new drugs and by May 2006 for all drugs currently on the market, including those compounded by hospitals.[4]

- The survey results suggest that although use of bar coding remains relatively uncommon in the Canadian environment, the adoption of this technology is increasing. Twenty-two percent of respondents reported using bar code technology within the medication system, compared with only 11% in the 2001/02 survey. (Table H-4).
- Of the 32 respondents reporting bar code technology, 72% (23/32) were teaching institutions, while few respondents (9% 3/32) were in the 100-200 bed category. The Prairies lead the application of bar code technology with an implementation rate of 43% (9/21), compared with 17-22% for other regions.

- The 2003/04 survey indicated a small increase in the types of functions for which bar code technology was applied, such as verification of drug selection prior to medication administration and identification of the patient prior to medication administration. Only one respondent, from British Columbia, reported using bar code verification of the drug and patient during medication administration.
- The current survey reported a small increase in respondents using bar codes to verify drug selection prior to dispensing from pharmacy (Five respondents in 2003/04 compared with one in the 2001/02 survey).
- The most common function for which respondents reported bar code use was returning doses to inventory, (11 respondents), followed by verification of drug selection from pharmacy, (five respondents) and verification of automated dispensing cabinet stocking (five respondents) - (Figure H-2).

Figure H-2 Uses of Bar Coding



Base: Respondents reporting use of bar coding in medication system (32)

Table H-4. Bar Coding 2003/04

Hospitals (n=)	All (144)	Bed Size 100-200 (38)	Bed Size 201-500 (68)	Bed Size >500 (38)	Teaching Status Yes (56)	Teaching Status No (88)
Bar Coding used in Medication System	22% (32)	8% (3)	21% (14)	39% (15)	41% (23)	10% (9)
Bar Coding is used to… (n=32)						
Return doses to inventory	11	0	5	6	8	3
Verify drug selection prior to dispensing from pharmacy	5	1	1	3	3	2
Verify unit dose bin stocking	4	1	0	3	2	2
Verify automated dispensing cabinet stocking	5	1	2	2	4	1
Verify drug selection prior to patient administration	1	0	1	0	1	0
Identify the patient during medication administration	1	0	1	0	1	0
Other	15	2	6	7	12	3

Medication systems analysis in the literature indicates 34% of medication related errors occur at the bedside during the medication administration phase. Generally, very few of these are intercepted before administration to the patient. A further 10% of medication related errors occur during the transcription and dispensing phase. [5] [6]

- Bar code technology applied to the medication administration activities may significantly reduce these errors, yet only one hospital reported using bar coding for drug medication administration (3%, 1/32). Even in the US, where bar code systems have been available and in use for several years, the ASHP National Survey of Pharmacy Practice Dispensing and Administration [7] reports that, in 2002, of over 500 responding hospitals, only 1.5% use bar code technology to check administered doses, a small change from 1.1% in 1999.

Summary

Technological advancements have rapidly progressed in recent years and innovative technologies to improve the safety and efficiency of medication systems have become a reality. Yet, despite the growing complexities of patient needs and the mounting evidence on the vulnerability of current medication systems, the survey data and literature reports indicate hospitals have been slow adopters of new technology to improve patient safety. Perhaps this is a symptom of the budgetary and infrastructure challenges within the Canadian healthcare system. Perhaps it is also indicative of competing priorities. Other industries, such as the airline and other transportation industries have been much more proactive and less tolerant of system failures.

The recent FDA requirement for manufacturers to place bar codes on all pharmaceutical and blood products should significantly enhance the ability and commitment of US hospitals to implement bar code technology.

The Canadian healthcare system is also experiencing increasing demands to focus on patient safety. This is an opportune time for hospitals to take a leadership role in transforming the Canadian healthcare system into one of unrivaled excellence. Judicious application of available technology and facilitation of optimal deployment of scarce human resources may facilitate the ability of hospitals to provide safe, effective and comprehensive patient care.

References

1. Baker, G.R. Norton. P.G. et. al. The Canadian Adverse Events Study: the incidence of adverse events among hospitalized patients in Canada CMAJ. 2004;170 (11):1678-86.
2. Bobb A, Gleason K, Husch M et al. The Epidemiology of Prescribing Errors. Arch Inter Med. 2004; 164: 785-92.
3. Bates, D.W. Leape L.L. et. al. Effect of CPOE and Team Intervention on Prevention of Serious Medication Errors. JAMA.1998; 280: 1311-1316.
4. FDA Releases Final Rule on Bar Coding. FDA Feb 25, 2004 www.ashp.org, www.fda.gov
5. Bates D.W. Cullen D.J. Laird N. et al. Incidence of Adverse Drug Events and Potential adverse Drug Events. Implications for Prevention. JAMA. 1995; 274: 29-34.
6. Leape, L.L., Bates D.W. Cullen D.J. et al. Systems Analysis of Adverse Drug Events. JAMA. 1995;274: 34-43.
7. Pedersen CA, Schneider PJ , Scheckelhoff DJ. ASHP National Survey of Pharmacy Practice in Hospital Settings: Dispensing and Administration – 2002. Am J Health-Syst Pharm. 2003;60:52-68.