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ORIGINAL ARTICLE

Hospital pharmacy practice in Saudi Arabia: Dispensing and administration in the Riyadh region

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Abstract *Background:* There is very little published data assessing hospital pharmacy practice in Saudi Arabia. Hence, a comprehensive survey has been undertaken to evaluate hospital pharmacy services of the Kingdom of Saudi Arabia. Recently, we published the survey results on the prescribing and transcribing steps of the medication use process. This paper focuses on dispensing and administration.

Methods: A modified-American Society of Health-System Pharmacists (ASHP) survey questionnaire was personally delivered to the pharmacy directors of 48 hospitals in the Riyadh region. Three attempted follow-ups were made within 3 months to non-responders and the surveys were collected upon completion. The survey was conducted using similar methods to those of the ASHP surveys.

Results: Twenty-nine hospitals participated in the survey with a response rate of 60.4%. Centralized distribution (74%) is the most commonly used model for inpatient pharmacies. Overall, 21% of hospitals routinely use bar coding technology in medication dispensing. None of the hospitals are using a robotic distribution system to automate the dispensing of unit doses. Automated dispensing cabinets (ADCs) are used by 21% of hospitals as part of their decentralized distribution model.

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Sixty-one percent of hospital pharmacies have IV admixture preparation area in their facility. In the use of safety technology for medication administration, only one third of hospitals are using electronic medication administration records (eMARs), 7.4% had bar-code-assisted medication administration (BCMA) and 12% had smart infusion pumps.

Conclusion: Hospital pharmacies in the Riyadh region are fairly well developed in providing dispensing and administration services. Further improvement can be achieved by increasing the use of new technologies such as bar-code technology, unit dose drug distribution systems, pharmacy-based IV admixture services, smart infusion pumps, and automated medication distribution.

1. Introduction

Hospital pharmacy departments are expected to optimize drug preparation, dispensing and distribution systems, and therefore, must develop comprehensive policies and procedures that provide safe distribution of all medications and related supplies to inpatients and outpatients (American Society of Hospital Pharmacists, 1980). One measure of the quality of any drug distribution system is the incidence of reported medication errors (Taxis et al., 1999). Several international pharmacy organizations have undertaken surveys to assess current hospital pharmacy practices in their respective countries. These surveys have evaluated practices at different times and their findings have guided strategic initiatives. The American Society of Health-System Pharmacists (ASHP) has conducted national surveys of pharmacy practice in hospital settings that pertain to dispensing and administration in 2002, 2005 and 2008 (Pedersen et al., 2003, 2006, 2009). The International Pharmaceutical Federation (FIP) Global Conference on the Future of Hospital Pharmacy also conducted a survey in 2005, which assessed multiple aspects of hospital pharmacy practice within each of the 192 countries recognized by the United Nations (Doloresco and Vermeulen, 2009). Similar surveys focusing on European practice have been conducted by the European Association of Hospital Pharmacists (EAHP), with the most recent one conducted in 2010 (European Association of Hospital Pharmacists, 2010). Likewise, every two years, the hospital pharmacy in Canada survey collects information about hospital pharmacy practice in their country (Hospital Pharmacy in Canada Editorial Board, 2011).

In Saudi Arabia, published studies assessing hospital pharmacy practice are very limited. Hence in 2010, a project was designed in collaboration between King Saud University College of Pharmacy, the Saudi Pharmaceutical Society (SPS) and the American Society of Health-System Pharmacists (ASHP) to survey the current state of hospital pharmacy practice in the country based on ASHP published survey. The modified survey, which has been conducted in hospitals of the Riyadh region focuses on assessing the role of pharmacists in managing and improving the medication-use system. It is organized according to the six steps in the medication-use system: prescribing, transcribing, dispensing, administration, monitoring, and patient education. The survey results for the first two steps (prescribing and transcribing) have been recently published (Alsultan et al., 2011).

This is the second article in the series which focuses on the dispensing and administration steps of the medication use process in hospitals of the Riyadh region. It examines the current structure and future direction of the medication distribution system for inpatient pharmacies, including the technology being utilized, the primary method to check unit doses and the methods used in the preparation and dispensing of medications. The use of technology in medication administration such as bar-code technology, smart infusion pumps, and medication administration records (MARs), pharmacist deployment in practice model current status and future direction, and lastly barriers faced in changing the practice model have also been evaluated.

Findings from this survey can be used by pharmacy practitioners looking for local data on key elements that can affect the safety and quality of the medication use process. They can be utilized as a base for benchmarks locally within the Kingdom of Saudi Arabia and externally to internationally published survey outcomes. It can also be used to track progress over time and help to identify opportunities for strategic initiatives and policies at a national level to improve practice. The results will also provide an indication of the overall picture of current practices in the kingdom.

2. Methods

2.1. Survey

Analysis of previous hospital pharmacy practice surveys and questions (e.g., ASHP national survey of pharmacy practice in hospital settings, Hospital pharmacy in Canada report, and FIP Global survey of hospital pharmacy practice) were carried out. Survey questionnaire as pertinent to Saudi Arabia were prepared by modification, addition and subtraction from ASHP survey questions in consultation with ASHP survey members. For this report, the major domains of the medication use process studied were dispensing and administration. The survey was conducted using methods similar to those of the ASHP surveys (Pedersen et al., 2008, 2009, 2010, 2011).

The pharmacy directors of 48 hospitals according to Ministry of Health (MOH) records (Saudi Ministry of Health Portal, 2011) in the Riyadh region were asked to participate in the survey. Details of the survey were discussed with some pharmacy directors prior to finalizing the survey and completed surveys were distributed and data was collected and analyzed accordingly. To increase the response rate, three attempted follow-ups were made within three months and respondents were promised to receive a complimentary copy of the 2010 Saudi National Formulary (SNF). Any hospital pharmacy that did not respond during the study period was considered a non-responder. Each booklet of the survey questionnaire was assigned a serial number.

In assessing the role of the pharmacist in dispensing, the present study sought to describe the currently available

Table 1 Size, ownership and accreditation of respondents' hospital.

Characteristics	Hospitals (n = 29)	
	N	(%)
Hospital size (Number of staffed beds)		
Small		
< 50	2	(6.9)
50–99	4	(13.8)
Total	6	(20.7)
Medium		
100–199	7	(24.1)
200–299	3	(10.3)
Total	10	(34.4)
Large		
300–399	3	(10.3)
400–599	4	(13.8)
⩾600	4	(13.8)
Total	11	(37.9)
Missing-no response	2	(6.9)
Occupied beds		
< 50	4	(13.8)
50–99	4	(13.8)
100–199	6	(20.7)
200–299	3	(10.3)
300–399	1	(3.4)
400–599	3	(10.3)
⩾600	3	(10.3)
Missing-no response	5	(17.3)
Ownership		
Government hospital	14	(48.3)
Private hospital	15	(51.7)
Accreditation		
Accredited	16	(55.1)

inpatient medication distribution systems, the use of technology in medication distribution and the methods for medication preparation and dispensing. The process of medication administration, the use of smart infusion pumps, the use of bar code technology, the use of medication administration records (MARs) and pharmacist practice and service models were evaluated to assess their role in administration.

2.2. Statistics

Data were entered into Predictive Analytics Software (PASW) Advanced Statistics version 18 (formerly called SPSS Advance Statistics, SPSS Inc., Chicago, Illinois) licensed for King Saud University. The data are summarized using descriptive statistics, categorized by hospital size as small (less than 100 beds), medium (100–299 beds) or large (300 or more beds).

3. Results

Twenty-nine of the 48 hospital pharmacies in the Riyadh region responded to the survey giving a response rate of 60.4%. The characteristics of respondent hospitals are shown in Table 1.

3.1. Pharmacy distribution system

Over 74% of hospitals currently have a centralized distribution system for inpatient medications (Table 2). Hospital pharmacy directors were also asked about the direction they would like their inpatient medication distribution system to go in the future. About 37% of hospital pharmacy directors responded that they would like a decentralized model in the future (Table 2).

3.2. Utilization of technology and automated solutions

The number (%) of hospital pharmacies which use technology as part of their drug distribution system are shown in Table 3. Automated dispensing cabinets (ADCs) are used by 21% of hospitals; 17.1% of hospitals use ADCs in their decentralized distribution system and 10.3% of hospitals use ADCs linked to the pharmacy computer system or an integrated patient health record (profiled ADCs).

Overall, 20.6% of hospitals routinely use machine-readable coding e.g., bar coding technology with or without a robot in the inpatient pharmacy to verify doses before dispensing. The survey also showed that none of the responding hospitals used a robotic distribution system to automate the dispensing of unit doses of inpatient medications.

3.3. Pharmacy and unit dose dispensing

For this survey, a unit dose was defined as a dose dispensed by the pharmacy that is ready to administer to a patient (i.e., no further dosage calculation or manipulation is required). For non-critical care beds, 67.7% of all hospitals dispensed 50% or more of oral medication in unit dose form (Table 4). Hospital pharmacy directors were asked about the primary method used to check unit doses dispensed by their pharmacy. The survey results showed that the majority of hospitals (65.4%) had

Table 2 Number (%) of hospitals with the current structure of their pharmacy distribution system and views of its future direction.

Characteristics	Current structure (n = 27)		Future direction (n = 27)	
	Centralized	Decentralized	Centralized	Decentralized
Hospital size (no. of beds)				
Small < 100	5 (18.5)	1 (3.7)	6 (22.2)	1 (3.7)
Medium (100–299)	9 (33.3)	2 (7.4)	5 (18.5)	5 (18.5)
Large ⩾300	6 (22.2)	4 (14.8)	6 (22.2)	4 (14.8)
Total	20 (74.0)	7 (25.9)	17 (62.9)	10 (37.0)

Number of hospital respondents = 27; percentages based on total number of hospital respondents.

Table 3 Number (%) of hospitals using different types of technology in the pharmacy drug distribution system ($n = 29$).

Characteristics	Robot	Bar coding	Medication dispensing through ADCs	ADCs in decentralized system	ADCs linked to pharmacy computer
Hospital size (no. of beds)					
Small □100	0	2 (6.9)	1 (3.4)	1 (3.4)	0 (0.0)
Medium (100–299)	0	2 (6.9)	2 (6.9)	1 (3.4)	1 (3.4)
Large ⩾300	0	2 (6.9)	3 (10.3)	3 (10.3)	2 (6.9)
Total	0	6 (20.6)	6 (20.6)	5 (17.1)	3 (10.3)

ADCs: automated dispensing cabinets; percentages based on total number of hospital respondents.

technicians prepare and pharmacists check unit doses (Table 4). The next most frequently used methods were having pharmacists prepare doses with no check (24.1%) and having technicians prepare and check the doses (10.3%).

3.4. Quality assurance for drug preparation and dispensing

Pharmacy directors were asked about the presence of a quality assurance programs that cover drug dispensing, intravenous (IV) admixture preparation in their pharmacies. A total of 65.5% of hospitals stated that they had a formal quality assurance program for evaluating medication preparation and dispensing.

3.5. IV admixture preparation area and preparation of IV doses by nurse

The survey results showed that the majority of hospitals (60.7%) had an IV admixture preparation area in their pharmacy. Nurses were required to prepare 21% of IV admixture and solution doses from vials or ampoules.

3.6. Use of commercially available ready-made parenteral products

A total of 40.9% of hospitals purchased one or more commercially available small-volume parenteral products and additionally, 54.5% of hospitals purchased commercially available premixed large-volume IV solutions whenever available.

3.7. Preparation of small volume parenterals

When pharmacy directors were asked how small volume parenteral doses are prepared and dispensed from their pharmacy, it was found that the most common system used for the preparation of small volume parenterals is minibag, which are used by 46.1% of hospitals (Table 5). Dispensing of vials to nurses for the purpose of preparing IV doses at the bedside was practiced by 34.5% of hospitals, followed by a pharmacy prepared syringes to be used in syringe pumps (26.8%) and a syringe for use in a volume control chamber or by IV push (23.1%).

3.8. Double-check process before dispensing

Overall, 68% of hospitals required a double check before dispensing medication to high risk patient population (e.g., pediatric patients) and 60% of hospitals required a two pharmacist check before dispensing high risk/alert medications such as chemotherapy (Table 5).

3.9. Automation used in total parenteral nutrition (TPN) preparation

Overall, 46.3% of hospitals prepare TPN in their pharmacy. As expected, TPN preparation was more common in large hospitals. Large volume base compounding devices and additives compounding devices were used by 36% of all hospitals (Table 5). The devices were more likely to be used in large or medium sized hospitals.

Table 4 Number (%) of hospitals with the primary method used to check unit doses dispensed by pharmacy ($n = 29$) and the proportion of doses dispensed in unit dose form ($n = 28$).

Characteristics	Hospitals engaged in activity			
	Small < 100	Medium (100–299)	Large ⩾300	Total
Primary method to check unit doses dispensed (n = 29)				
Pharmacist fills/no check	2 (6.9)	3 (10.3)	2 (6.9)	7 (24.1)
Technician fills/pharmacist checks	4 (13.7)	7 (24.1)	8 (27.6)	19 (65.4)
Technician fills/technician checks	0 (0.0)	3 (10.3)	0 (0.0)	3 (10.3)
Proportion of doses dispensed in unit doses (n = 28)				
1–24%	1 (3.6)	0 (0.0)	1 (3.6)	2 (7.2)
25–49%	2 (7.1)	2 (7.1)	1 (3.6)	5 (17.8)
50–74%	2 (7.1)	5 (17.8)	3 (10.7)	10 (35.6)
75% or more	0 (0.0)	3 (10.7)	6 (21.4)	9 (32.1)
Not applicable	1 (3.6)	1 (3.6)	0 (0.0)	2 (7.2)

Percentages based on total number of hospital respondents.

Table 5 Number (%) of hospitals using predominant form of small volume parenteral dose preparations (n = 26), two-pharmacist check before dispensing (n = 25), Total Parenteral Nutrition (TPN) preparation (n = 28) and Automation to support TPN preparation.

Characteristics	Hospitals engaged in activity			
	Small < 100 *n* (%)	Medium (100–299) *n* (%)	Large ⩾300 *n* (%)	Total *n* (%)
Mini-bag	2 (7.7)	5 (19.2)	5 (19.2)	12 (46.1)
Syringe for infusion pump	1 (3.8)	3 (11.5)	3 (11.5)	7 (26.8)
Syringe for volume control chamber, or IV push	0 (0.0)	2 (7.7)	4 (15.4)	6 (23.1)
Vial to be prepared by nurse	1 (3.8)	5 (19.2)	3 (11.5)	9 (34.5)
Other	1 (3.8)	1 (3.8)	2 (7.7)	4 (15.3)
Use of two-pharmacist check (n = 25)				
High risk patient groups (e.g., pediatrics)	5 (20.0)	6 (24.0)	6 (24.0)	17 (68.0)
High risk medication therapies (e.g., chemotherapy)	3 (12.0)	6 (24.0)	6 (24.0)	15 (60.0)
TPN preparation (n = 28) and automation used to support TPN preparation (n = 25)				
TPN preparation	1 (3.6)	4 (14.2)	8 (28.5)	13 (46.3)
Large-volume base compounder	0 (0.0)	2 (8.0)	7 (28.0)	9 (36.0)
Additive compounder	1 (4.0)	4 (16.0)	4 (16.0)	9 (36.0)

TPN: Total parenteral nutrition; percentages based on total number of hospital respondents.

3.10. Safe medication administration practices

The number (%) of hospital pharmacies which utilize safety technology in medication administration are shown in Table 6. Two-thirds of all respondent hospitals use handwritten MARs and one third uses electronic MARs, with 25.9% using computer generated paper MARs. Only two (7.4%) of respondent hospitals are currently using Bar-code-assisted medication administration (BCMA) to verify the identity of the patient and the accuracy of medication administration at the point of care. Apart from the hospitals that had BCMA, 72% of hospitals planned to implement a BCMA system within next three years, 4% in more than three year and 24% of hospitals had no current plan to implement a BCMA system.

3.10.1. Smart infusion pump

Only three (12%) of respondent hospitals are currently using smart infusion pumps.

3.10.2. Standardized drug concentration for IV infusions

Pharmacy directors indicated that their hospitals have approved policies that endorse the use of standardized drug concentrations for IV infusions to promote patient safety. Most pharmacy directors (69.2%) reported having a written policy and 60% of them have effectively implemented these policies.

3.11. Pharmacy practice model

There are variations in the type of pharmacy practice model implemented at hospitals in Riyadh region. The survey included questions concerning three types of pharmacy models: a drug distribution centered model (defined as "mostly distributive pharmacy with limited clinical services"), a patient centered integrated model (defined as "clinical generalist model with limited differentiation of roles- nearly all pharmacists have distributive and clinical responsibility") and a clinical–specialist-centered model (defined as "separate distributive and clinical specialist roles").

Overall, 62.1% of hospitals used a drug distribution centered model, 20.7% used a clinical specialist centered model and 17.1% used a patient centered integrated model (Table 7). None of the small hospitals participating in the survey used a clinical specialist centered model.

Hospital pharmacy directors also provided information on their future plans for pharmacists' deployment to patient care areas. Most hospitals (62.1%) anticipated having a patient centered integrated model with only 3.4% of them anticipating having a drug distribution centered model in the near future (Table 7). Most pharmacy directors (69%) are currently working towards changing their practice model, or had already changed their pharmacy practice model in the last 3 years.

3.12. Barriers in changing practice model

Pharmacy directors were asked what barriers the pharmacy departments are currently experiencing while changing practice model. The survey results are shown in Table 8. The three most common barriers given by pharmacy directors were lack of enough qualified pharmacist with proper training (51.7%), lack of hospital leadership support (44.8%) and lack of qualified pharmacy technician (41.3%).

4. Discussion

The survey is the first of its kind in the Middle East. It provides a descriptive data and the results give baseline information for the first time on current status of pharmacy practice pertaining to dispensing and administration in hospitals of Riyadh region in Saudi Arabia. The results of our survey showed comparable figures to ASHP survey with regards to centralized distribution of medications in hospital pharmacies. In the United States of America, most (75%) of the smaller hospitals have centralized distribution which are not automated whereas larger hospitals have both centralized and decentralized distribution systems which are partially or fully automated (Pedersen et al., 2003, 2006, 2009). A Canadian study also showed that centralized

Table 6 Number (%) of hospitals using safety technology for medication administration.

Characteristics	Hospitals engaged in activity			
	Small < 100	Medium (100–299)	Large ⩾300	Total
Documentation of medication administration (n = 27)				
Handwritten MAR	5(18.5)	7 (25.9)	6 (22.2)	18 (66.6)
Computer generated paper MAR	3 (11.1)	3 (11.1)	1 (3.7)	7 (25.9)
e-MAR	3 (11.1)	3 (11.1)	3 (11.1)	9 (33.3)
Using BCMA	1 (3.7)	1 (3.7)	0	2 (7.4)
Planning to implement a BCMA system (n = 25)				
BCMA within next 12 months	2 (8.0)	3 (12.0)	2 (8.0)	7 (28.0)
BCMA between 1 and 3 years	1 (4.0)	5 (20.0)	5 (20.0)	11 (44.0)
BCMA in more than 3 years	1 (4.0)	0 (0.0)	0 (0.0)	1 (4.0)
No current plans to implement a BCMA system	1 (4.0)	2 (8.0)	3 (12.0)	6 (24.0)
Other				
Using smart infusion pumps (n = 25)	1 (4.0)	1 (4.0)	1 (4.0)	3 (12.0)
Policies for the use of standardized drug concentration for i.v. infusions (n = 26)	4 (15.4)	5 (19.2)	9 (34.6)	18 (69.2)
Implementation of standardized drug concentration for i.v. infusions (n = 25)	3 (12.0)	4 (16.0)	8 (32.0)	15 (60.0)

MARs: Medication administration records, e-MAR: Electronic medication administration record system, BCMA: bar code assisted medication administration, n = number of hospital respondents; percentages based on total number of hospital respondents.

Table 7 Number (%) of hospitals with deployment of pharmacist in practice model, current status and future direction (n = 29).

Characteristics	Hospitals engaged in activity			
	Small □100	Medium (100–299)	Large ⩾300	Total
Pharmacists in practice model: current status				
Drug distribution centered model	4 (13.8)	8 (27.6)	6 (20.7)	18 (62.1)
Patient centered integrated model	3 (10.3)	1 (3.4)	1 (3.4)	5 (17.1)
Clinical–specialist-centered model	0 (0.0)	2 (6.9)	4 (13.8)	6 (20.7)
Pharmacists in practice model: future direction				
Drug distribution centered model	0 (0.0)	0 (0.0)	1 (3.4)	1 (3.4)
Patient centered integrated model	7 (24.1)	4 (13.8)	7 (24.1)	18 (62.1)
Clinical–specialist-centered model	0 (0.0)	7 (24.1)	3 (10.3)	10 (34.4)

Percentages based on total number of hospital respondents.

distribution is used in 70% of their hospitals (Hospital Pharmacy in Canada Editorial Board, 2011). Despite our smaller sample size, our result is consistent with ASHP finding as 83% (5 out of 6) of our small hospitals used a centralized distribution system. Almost 37% of the pharmacy directors have shown a desire to move towards a decentralized distribution system in the future compared to a current use of 26%.

Automated pharmacy services are replacing some of the routine, time-consuming filling procedures since they increase accuracy and improve efficiency and reduce medication errors. A study in United States conclude that implementation of new technology into the medication management system standardized the medication administration processes, decreased turnaround time for processing medication orders, and increased accuracy of medication administration to patients (Skibinski et al., 2007). Also, a study conducted in Saudi Arabia has shown that implementation of an automated drug dispensing system (ADDS) improved the efficiency of drug distribution, assisted in cost containment, and decreased the total number of medication adverse event (MAEs) (Dib et al., 2006).

However, in our study, none of the respondent hospitals have used a robotic drug distribution system within their centralized distribution system and relatively few (20.7%) hospitals used automated dispensing cabinets (ADCs). This gives an indication that the use of some technological solutions for distributing medication in hospital pharmacies in Saudi Arabia is in its early stages and despite the fact that specific hospitals in Saudi Arabia are known to practice at international standards (Accreditation Canada International, 2012; King Faisal Specialist Hospital and Research Centre, 2010-2011). However, the overall current practices are uncertain. On the other hand, there has been a rapid increase in the adoption of ADCs in other countries such as the U.S (an increase in from 49% in 1999 to 83% in 2008); (Pedersen et al., 2009) and Canada (36% in 2007/08 to 53% in 2009/10); (Hospital Pharmacy in Canada Editorial Board, 2011).

The use of bar-code technology has been shown to reduce the risk of medication errors (Poon et al., 2006, 2010). A study by Ragan and co-workers showed that bar-code integrated medicine packaging and distribution system improved dispensing accuracy (Ragan et al., 2005). Overall, only modest percentage respondents in our survey reported that they routinely used machine-readable coding in the inpatient pharmacy to check medications before dispensing. The above pattern is supported by other studies conducted in the United States and Canada, wherein 24% (Pedersen et al., 2009) and

Table 8 Number (%) of hospitals with barriers to changing practice model ($n = 29$).

Barriers	Hospitals engaged in activity			
	Small □100	Medium (100–299)	Large ⩾ 300	Total
Lack of automation to support change	2 (6.9)	4 (13.8)	3 (10.3)	9 (31.0)
Lack of hospital leadership support	4 (13.8)	4 (13.8)	5 (17.2)	13 (44.8)
Lack of pharmacist staff with required training	3 (10.3)	6 (20.7)	6 (20.7)	15 (51.7)
Lack of pharmacist staff resources	0 (0.0)	4 (13.8)	4 (13.8)	8 (27.6)
Lack of qualified pharmacy technician staff	1 (3.4)	5 (17.2)	6 (20.7)	12 (41.3)
Resistance to change from current pharmacy staff	0 (0.0)	1 (3.4)	4 (13.8)	5 (17.2)
No barriers have been identified	0 (0.0)	0 (0.0)	1 (3.4)	1 (3.4)
Other	0 (0.0)	0 (0.0)	1(3.4)	1 (3.4)

Percentages based on total number of hospital respondents.

17% (Hospital Pharmacy in Canada Editorial Board, 2011) of hospitals used this technology. In 2004, the U.S. Food and Drug Administration (FDA) mandated that hospitals use bar codes for medication (Food and Drug Administration, 2004).

The ASHP considers the unit dose system to be an essential part of drug distribution (American Society of Hospital Pharmacists, 1989). The unit dose system is also endorsed by the Canadian Society of Hospital Pharmacists (CSHP) as the drug system of choice in organized healthcare settings (Canadian Society of Hospital Pharmacists, 2008). Unit dose drug distribution system has been shown to save money and reduce the chance of medication errors (American Society of Hospital Pharmacists, 1989; Taxis et al., 1999). Our survey result showed that for non critical care beds, 67.7% of hospitals dispensed 50% or more of all oral medications in unit dose form which is lower than the finding of ASHP study where 79.9% of hospitals dispensed 75% or more in unit dose form (Pedersen et al., 2009). We also noted that only 60.7% of our hospitals have an IV preparation area in the pharmacy where IV medications are prepared. Our study result suggests that IV doses are not optimally prepared by pharmacy services for a significant percentage of patients, due to the lack of IV admixture area. It is imperative that hospitals establish IV preparation areas in the near future to improve sterility, compatibility, calculation accuracy, and labeling of IV medications which should reflect positively on patient safety. On the other hand it was also observed that, one fifth of the respondent hospitals allow nurses to prepare i.v. admixture and solution doses from vials or ampoules. Such practice is recommended in emergencies or when the duration of product stability is short by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) (Rich, 2004).

Local and international accreditation standards recommend pharmacists to review medication orders for accuracy and appropriateness when possible before dispensing. Standard MM.4.10 (formerly TX.3.5.2) from the Joint Commission on Accreditation of Healthcare Organizations suggests that all drug orders should be reviewed by a pharmacist for appropriateness before dispensing, unless it is an urgent situation when a delay would harm the patient or a licensed independent practitioner controls the ordering, dispensing, and administration of the medication (Rich, 2004). The study result shows that 10% of hospitals had unit doses prepared by a pharmacy technician and double checked by another technician prior to dispensing by pharmacist. This is a good practice and is in conformity to other study conducted by Reed et al. (Reed et al., 2011) who concluded that such process reduces interruptions in the pharmacists' daily workflow and allowed pharmacists to spend more time on patient care activities. On the other hand, for high risks groups and medications (such as pediatric patients and chemotherapy), 68% of respondent hospitals reported that these were checked by two pharmacists before dispensing. In order to reduce the risk of harm, many hospitals have identified high-risk groups (pediatric) and high-risk medicines (chemotherapy) and taken steps to ensure that the order-review process is performed before dispensing medicines. In U.S, none of the State Boards of Pharmacy require two pharmacists check prior to dispensing chemotherapy or to high risk group patients. However, ASHP has developed comprehensive guidelines on chemotherapy-error prevention (American Society of Health-System Pharmacists, 2002) and Joint Commission International for Accreditation (JCIA) mandates double checking for high alert medications.

Human errors are becoming more prevalent in administration of medication due to many reasons including shortage of well trained staff in many hospitals. Handwritten MARs are particularly prone to error as they require transcription and can be difficult to read. The electronic Medication Administration Records (eMAR) helps in reducing medication errors by eliminating or reducing transcribing ambiguity. The system prevents the wrong medication being given to a patient or being given to the wrong patient especially when the system is integrated with BCMA. In one study, a 54% reduction of medication administration errors was observed following implementation of electronic MARs and BCMA (Paoletti et al., 2007). Our survey result indicates that 33% of hospitals used an electronic MAR and only 7.4% of the hospitals have BCMA to verify the patient identity and accuracy of medication administration at point of care. In contrary to our finding, the recent ASHP survey reported that only 16.5% of hospitals used handwritten MARs and 36.6% used an electronic MARs in the U.S (Pedersen et al., 2009). It is promising to see that almost 72% of the hospital pharmacy directors responding to our survey plan to implement a BCMA system within the next three years.

Intravenous medication administration errors are common and studies have estimated that conventional infusion pumps contribute to 35–60% of Adverse Drug Events (ADEs) each year (Husch et al., 2005). The use of smart infusion pumps in hospitals has been shown to reduce medication administration errors by alerting nurses when pump settings do not match the drug administration guidelines (Institute for Safe

Medication Practices, 2002; Nicholas and Agius, 2005). Smart pumps are relatively simple to implement and have an instant positive impact compared to other patient safety technologies (Wilson and Sullivan, 2004). Our study demonstrates that only 12% of hospitals used smart infusion pumps whereas a recent ASHP survey revealed that the use of smart infusion pumps in U.S hospitals had increased from 32% in 2005 to nearly 60% in 2008 (Pedersen et al., 2009).

While numerous benefits have been pushed for new medication administration technologies adoption, also, there are confusion associated with implementing and using these new technologies that cannot be ignored. A recent literature review evaluated the research evidence on relationships between the use of medication administration technologies and incidence of medication administration incidents revealed that further evidence is required to accurately assess the actual contribution of medication administration technologies for improving patient safety (Wulff et al., 2011). Another literature review of published evidence on the effects of computerized physician order entry (CPOE), automated dispensing machines (ADMs), bar coding, and computerized medication administration records (CMARs) on medication errors and adverse drug events (ADEs) concluded that very little evidence on the appropriateness of the use of these technologies existed(Oren et al., 2003) .

Recently, the ASHP foundation has taken initiatives to promote pharmacists as direct patient care providers. This is in line with an integrated patient-specific model of pharmacy practice which places pharmacists in a professional relationship with patients. The ASHP survey in 2008 showed that only 25.8% hospitals in U.S used a drug distribution centered model (Pedersen et al., 2009), whereas our survey data indicated that the majority of hospitals (62.1%) in Riyadh region utilize a central drug distribution system. Almost 62% of the hospital pharmacy directors indicated that they have future plans for the deployment of pharmacists in a patient centered integrated practice model. The insufficient supply of pharmacists with the necessary training, lack of hospital leadership support and lack of qualified pharmacy technician staff have created a significant challenge for pharmacy departments who are attempting to change their pharmacy practice model. In Saudi Arabia, 15 schools of pharmacy have recently implemented a six-year entry level Doctor of Pharmacy (Pharm.D.) program to improve the situation and their mission is to promote the ''pharmacist as direct patient care provider'' in the hospital setting. A recent US survey has shown that new practitioners have a greater preference for clinical, direct patient care activities compared with traditional operational functions (Hertig et al., 2011), and it is hoped that newly trained pharmacists will help in the shift towards a patient centered integrated practice model.

One of the limitations of our survey is the small sample size relative to other international surveys such as the ASHP study. However, despite our small sample size, we have covered most of the prominent small and large hospitals in the region and consider the sample to be representative of hospitals in the Riyadh region.

5. Conclusion

Hospital pharmacies in the Riyadh region are fairly well developed in providing dispensing and administration service. Further improvement can be achieved by increasing the use of new technologies such as bar-code technology, unit dose drug distribution systems, pharmacy-based IV admixture services, smart infusion pumps, automated medication distribution and electronic prescribing that all have the potential to support patient care and improve medication safety. Furthermore, some of the above mentioned-technologies will relieve pharmacists from time consuming distribution activities and they will be able to devote more time in direct patient care service.

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