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Original Research

Impact of automated drug dispensing system on patient safety

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Abstract

Objectives: Automated drug dispensing system (ADDs) is an emerging technology positively impacts drug dispensing efficiency by minimizing medication errors. However, the pharmacist perception of the impact of ADDs on patient safety is not well-established. This cross-sectional observational study aimed to evaluate the dispensing practice and pharmacist perception of ADDs towards patient safety through a validated questionnaire. **Methods:** A self-designed questionnaire was validated and the pharmacist perception of dispensing practice was compared between two hospitals adopting ADDs and traditional drug dispensing system (TDDs). **Results:** The developed questionnaire had an excellent internal consistency (both Cronbach's α and McDonald's ω coefficients were >0.9). Factor analysis retained three significant factors (subscales) that explained pharmacist perception of dispensing system, dispensing practice, and patient counseling ($p<0.001$ for each factor). The average number of prescriptions dispensed per day, drugs contained in each prescription, average time for labeling each prescription and inventory management were significantly varied between ADDs and TDDs (p=0.027, 0.013 0.044 and 0.004, respectively). The perception of pharmacists using ADDs on three domains were higher than the TDDs. The pharmacists in ADDs agreed that they had enough time to review the medications before dispensing than TDDs and this difference was found to be statistically significant (p=0.028). **Conclusions:** ADDs was highly effective in improving dispensing practice and medication review; however, the pharmacists need to emphasize the importance of ADDs to translate the pharmacists' freed-time towards patient care.

Keywords: drug dispensing; pharmacist; perception; patient safety; factor analysis

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INTRODUCTION

Medication error is a global healthcare concern because it has been associated with 5% to 6% of hospital admissions and significant patient harms across the world.[1,2] A nationwide study in Saudi Arabia recently reported that the medication error was estimated at about 0.15% and associated with significant morbidity and patient harm.[3] This is considered as a potential challenge for hospitals and it compels to adopt new strategies to improve patient safety.[4] The Automated Drug Dispensing system (ADDs) is a relatively novel drug dispensing system approved by the American Society of Health-System Pharmacists and it has increasing evidence to improve patient care by saving time and reducing the workload of healthcare professionals and minimizing medication errors.[5-8] Moreover, ADDs have been advocated to decrease the rate of Adverse Drug Events (ADE)[9] and enhance work capacity, accurate inventory

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control and timeliness in medication availability.[5,7] In contrast, other studies reported, the evidence is lacking to understand the relationship between ADDs in the context of improved patient outcomes[10] and its role in minimizing ADE.[11] Henceforth, patient safety in ADDs is yet to be established according to the conclusive reports.[6] Other studies recommended careful implementation of ADDs to rule out patient risk.[12,13]

The adoption of ADDs in controlled drug distribution improved the transparency and accountability while transaction[14] and reduced nursing time due to rapid retrieval[15]; however, manual counts still noteworthy in this regard to achieve patient safety.[13] Undoubtedly, ADDs save pharmacist time that allows them to focus on medication management and optimization of drug therapy.[10,16] However, the success of the ADDs is institution-specific[17] and their decision making process[6] and warrants a unique tool to understand patient safety in ADDs.

More than a decade ago, 97% of hospital pharmacies in the United States implemented automation technology in medication supply and distribution processes.[18] Recently, Saudi Arabia started adopting ADDs in their largest hospitals to ensure the quality in patient care.[19-21] One study conducted in Jeddah city, Saudi Arabia, addressed the errors with adoption of ADDs followed by the consequences of ADE.[19] These researchers recommended that the future research to address the pitfalls in implementing ADDs for patient safety.[19] To our knowledge, there is no unique tool to determine patient safety in ADDs and this should be considered as an urgent need to ensure better patient outcomes. Therefore, the present study planned to develop a pioneer tool to understand patient safety in ADDs. Also, the study planned to investigate the pharmacist perception of ADDs by comparing with traditional drug dispensing system (TDDs) through the validated questionnaire.

MATERIALS AND METHODS

Study design and study site

This observational study was conducted on two governmental tertiary care hospitals; one hospital adopted ADDs and the other used TDDs.

Ethics committee approval

The study was approved (TU-077/021/112) by the regional Institutional Review Board, Ministry of Health, Saudi Arabia.

Study population

Pharm.D clerkship students of Faculty of Pharmacy, and hospital pharmacists who involved in the dispensing of medication were eligible to participate in the study.

Sample size calculation & statistical analysis

Pilot study

Pilot study was included 49 Pharm.D clerkship students to validate the questionnaire.

Main survey

The sample size was calculated by using the following formula[22]

Sample size (n) = $2SD^2 (Z\alpha/2 + Z\beta)^2/d^2$

Standard deviation (SD) = 0.88 [23]

Type I error at 5% ($Z\alpha/2$) = $Z0.05/2$ = $Z0.025$ = 1.96 at 5%

Type II error at 80% power ($Z\beta$) = $Z0.20$ = 0.842 at 80% power

Effect size (d) = 0.8

$n = 2 (0.88)^2 (1.96+0.84)^2/0.8^2 = 18.97$

Therefore, we determined the sample size for the main survey is 20 in each group.

Designing the questionnaire

The questionnaire was developed based on the published evidence of the effectiveness of automated systems in improving medication safety, workflow productivity, and healthcare professionals' perceptions from the previous studies[17,24] and designed according to the scope of the present study to include three parts

Part I: The demographics of the hospital pharmacists (i.e. age, gender, positions, qualification, and distribution)

Part II: Dispensing practice of the pharmacist (i.e. the average number of prescriptions dispensed per day, the average time for dispensing each prescription, average number of drugs contained in each prescription, average time for labeling in each prescription, the average number of prescription error detected per day, the average number of dispensing high alert medication per day, average time for patient counseling for each patient, number of pharmacists in your pharmacy usually review the drugs before dispensing, and inventory control duration)

Part III: Pharmacist perception of their dispensing service (such as whether dispensing supports skills, and enables sufficient time to review the prescriptions and counsel patients, Table 1)

The questionnaire was evaluated initially with the experts in English for the language and the components were evaluated with the experts in pharmacy practice research. The corrections were adopted as per the suggestions from the experts.

Data collection

The data collection was carried out over eight months between September 2021 to April 2022. The paper based questionnaire was distributed directly to the clerkship students (pilot study) and licensed pharmacists (survey) working in the two tertiary care hospitals. The students and pharmacists were included based on prior appointments and agreed consents for participation through telephone or email. The participant name was not included to rule out the bias.

Statistical analysis

Validation of questionnaire

A 5-point Likert scale (Strongly disagree = 1 to Strongly agree = 5) questionnaire for pharmacist perception of their dispensing

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service (Part III) was distributed to clerkship students for validation.

Reliability statistics for internal consistency

The reliability was assessed with the calculation of Cronbach's α and Mc Donald's ω coefficients, and the interpretation included that values of 0.91 to 1.00 are excellent; 0.81 to 0.90 are good; 0.71 to 0.80 are acceptable; 0.61 to 0.7 are questionable; 0.1 to 0.6 are unacceptable.[25,26]

Validation

The construct validity of the questionnaire was tested by using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Exploratory Factor Analysis

The EFA was included in various measurements factor analyses were factors loading (the value close -1or 1 indicates the factor strongly influencing the variable; the value close to zero indicates the factor influencing the variable poorly),[27] Eigenvalue for essential items that should be retained in each factor,[28] and percentage of variance.[29] Kaiser-Meyer-Olkin test for sample size adequacy for factor analysis (KMO; ≥ 0.90-marvellous, 0.80 to 0.89 - meritorious, 0.70 to 0.79 - average, 0.60 to 0.69 – medicore, less than 0.5 – unacceptable)[30] and Bartlett's test of sphericity (<0.001) were included for the measurement of sampling adequacy.[31]

Confirmatory Factor Analysis

In CFA, a chi-square test was used to assess the degree to which the case scenario fits for the evaluation.[32] Root mean square error of approximation (RMSEA), comparative fit index (CFI), tucker-lewis index (TLI) > 0.95 and standardized root mean square (SRMR) were used as fit indices for good model fit.[33,34]

The comparison between the TDDs and ADDs was analyzed using the student's 't' test. Chi-square test was used to investigate the distribution of beds and pharmacists' demographics with regard to gender, age, the position of pharmacists, qualifications and distribution of pharmacists. P<0.05 was considered significant with a 95 % confidence interval. Statistical Package of Social Sciences (SPSS) was used to perform all the above mentioned statistical analyses.

RESULTS

Validation of questionnaire

A total of 49 clerkship students, of whom 25 were female and 24 were male, completed part III Likert scale of the questionnaire of the pharmacist perception on their dispensing practice, dispensing system and patient counselling (Table 1).

Reliability statistics for internal consistency

The internal consistency was established for the questionnaire (Table 1) since the Cronbach's α and Mc Donald's ω coefficient were > 0.8 in both the item and scale statistics. Therefore, the questionnaire was considered for factor analysis.

Exploratory Factor Analysis

All the 10 items included in questionnaire III were subject to evaluate the factorial validity of the scale. Three factors (subscales) included for EFA were pharmacist perception of the dispensing system, dispensing practice, and patient counseling. Questions 1, 9 and 10 in both the questionnaires belonged to the dispensing system. Dispensing has questions 2,3,4,5 and 8 followed by patient counseling including questions 6 and 7 (Table 2).

In EFA of the questionnaire (Table 2), the Kaiser-Meyer-Olkin (> 0.8) and Bartlett's test of sphericity (p <0.001) suggested that these data were suitable and had adequate sample size for factor analysis.[30,31] Moreover, all the items in factor loadings were close to 1, Eigenvalue (≥ 1) and percentage of variance (~50%) which indicated the factors were well explained by the questions included in the questionnaire.[27-29] Therefore, all the factors with the corresponding questions were retained[32] and proceeded further for confirmatory factor analysis.

Table 1. Reliability statistics for English questionnaire III (pharmacist perception)

Variable	Item statistics		Scale statistics	
	Cronbach's α	Mc Donald's ω	Cronbach's α	Mc Donald's ω
Do you feel your dispensing system adopted in your pharmacy supports your skill?	0.894	0.899	0.905	0.910
Do you have sufficient time to review (check for prescription error) for each prescription?	0.894	0.899		
Do you have sufficient time to dispense each prescription?	0.890	0.896		
Do you have sufficient time to label each prescription?	0.904	0.910		
Do you have sufficient time to review the medications before dispensing?	0.904	0.909		
Do you have sufficient time to answer the patient questions?	0.895	0.901		
Do you have sufficient time for patient medication counseling?	0.892	0.898		
Do you have sufficient time for inventory control (maintenance of stock) in your pharmacy?	0.884	0.890		
Is the dispensing system in your pharmacy considered safe to the patient?	0.896	0.901		
Is the dispensing system in your pharmacy need to be changed in your hospital?	0.902	0.905		

0.91 to 1.00 is excellent; 0.81 to 0.90 is good; 0.71 to 0.80 is acceptable; 0.61 to 0.7 is questionable; 0.1 to 06 is unacceptable

Table 2. Exploratory Factor Analysis for English questionnaire III (Pharmacist perception)

Variable	Factor analysis			Test for sample adequacy			
	Factor loadings*	Eigen value	% of variance	KMO-MSA**	Bartlett's test of sphericity		
					χ^2 value	df	p value
Dispensing system (Factor 1)							
Do you feel the dispensing system adopted in your pharmacy supports your skill?	0.998	1.704	56.8%	0.906	24.2	3	<0.001
Is the dispensing system in your pharmacy considered safe to the patient?	0.768	0.008					
Is the dispensing system in your pharmacy need to be changed in your hospital?	0.737	-0.001					
Dispensing practice (Factor 2)							
Do you have sufficient time to review (check for prescription error) for each prescription?	0.844	2.433	48.7%	0.813	49.3	10	<0.001
Do you have sufficient time to dispense each prescription?	0.844	0.279					
Do you have sufficient time to label each prescription?	0.708	0.009					
Do you have sufficient time to review the medications before dispensing?	0.706	-0.109					
Do you have sufficient time for inventory control (maintenance of stock) in your pharmacy?	0.650	-0.171					
Patient education (Factor 3)							
Do you have sufficient time to answer the patient questions?	0.721	1.040	52%	0.900	28.67	1	<0.001
Do you have sufficient time for patient medication counseling?	0.721	0.00					

Confirmatory Factor Analysis

In CFA, the three-factor structure was used to examine the confirmatory factor analysis (Table 3). Test for exact fit ($\chi2$ = 7.16; p= 0.128) with low $\chi2$ value and higher p value[26] and Fit indices RMSEA (0.042) and SRMR (0.059) were indicates good model fit since ≤ 0.06 and ≤ 0.08 respectively.[33,34] Further, both the CFI (0.981) TLI (0.978) has > 0.95 indicating a good fit for the model.[33,34] Henceforth, the questionnaire was successfully validated using factor analysis and was distributed to the pharmacists for the survey.

Demographics of the hospitals that adopted ADDs and TDDs

The demographics of the hospitals that adopted ADDs and TDDs were compared in Table 4. Both the hospitals had an almost similar number of beds. The hospital adopted ADDs has a many number of pharmacists (n=24) than TDDs (n=18). The pharmacists aged between 31 – 50 years, male gender and pharmacists qualified with the bachelor degree were predominant in both hospitals. There was no statistically significant difference between the above mentioned demographic variables between the two hospitals.

Comparison of dispensing practice by the pharmacist between ADDS and TDDS

The pharmacists were asked to share their dispensing experience in questionnaire II (Table 5). Using ADDs, 45.83% of pharmacists dispensed more than 50 prescriptions per day compared with (27.77%) of pharmacists using TDDs. Also, more than 90% of pharmacists spent less than 5 minutes labeling the drugs using ADDs than TDDs (77.77%). The average number of prescriptions dispensed per day (p= 0.027) and the average time for labeling each prescription (p=0.044**)** were statistically significant. However, the average time for dispensing each prescription in both dispensing systems showed no statistical difference (p=0.343). However, 16.66% of prescriptions contained more than 11-15 drugs in TDDs; whereas, no

Table 3. Confirmatory Factor Analysis for English questionnaire III (Pharmacist perception)

Variable	Test for exact fit			Fit measures				
	χ^2	df	p value	90 % confidence interval	RMSEA	CFI	TLI	SRMR
Dispensing system	7.16	32	0.128	0.00 – 0.351	0.042	0.981	0.978	0.0595
Dispensing practice								
Patient education								

Table 4. Demographics of the hospitals and pharmacists in ADDS Vs. TDDS

Variable	ADDS	TDDS	χ^2 value	p value
Total number of beds in the hospital	252	270		
ICU	33	24	2.61	0.271
Emergency	32	40		
Inpatient	187	206		
Number of pharmacists	24	18		
Gender				
Male	14	9	0.28	0.591
Female	10	9		
Age				
20 -30 years	7	3	0.88	0.346
31 – 50 years	17	15		
Positions of Pharmacists				
Pharmacist	10	11	1.80	0.405
Senior Pharmacist	13	6		
Chief Pharmacist	1	1		
Qualifications				
Bachelor degree in Pharmacy	19	14	0.23	0.887
Master degree in Pharmacy	2	1		
Pharm.D	3	3		
Distribution of Pharmacists			1.72	0.630
Outpatient pharmacy	8	5		
Inpatient pharmacy	13	8		
Emergency pharmacy	2	4		
Compounding	1	1		

χ^2 – Chi-square statistics on distribution of demographic variable;
p < 0.05 in bold letters was considered as statistically significant

Table 5. Comparison of dispensing practice by the pharmacist between ADDS and TDDS

Variable	ADDS (24) n (%)	TDDS (18) n (%)	Degrees of freedom	Chi-square value	p value
Average number of prescriptions dispensed per day					
Less than 10	1 (4.16)	2 (11.11)	5	12.59	**0.027**
10-20	1 (4.16)	0			
21-30	1 (4.16)	7 (38.88)			
31-40	5 (20.83)	4 (22.22)			
41-50	5 (20.83)	0			
More than 50	11 (45.83)	5 (27.77)			
Average time for dispensing each prescription					
Less than one minute	2 (8.33)	2 (11.11)	2	2.13	0.343
1-5 minutes	16 (66.66)	8 (44.44)			
6 to 10 minutes	6 (25)	8 (44.44)			
More than 10 minutes	0	0			

Average number of drugs contained in each prescription					
1-5 drugs	11(45.83)	12(66.66)	2	8.61	**0.013**
6-10 drugs	13(54.16)	3(16.66)			
11-15 drugs	0(0)	3(16.66)			
More than 15 drugs	0	0			
Average time for labelling in each prescription					
Less than one minute	11(45.83)	2(11.11)	2	6.21	**0.044**
1-5 minutes	11(45.83)	12(66.66)			
6 to 10 minutes	2(8.33)	4(22.22)			
More than 10 minutes	0	0			
Average number of prescription error detected per day					
None	3(12.5)	0	3	3.74	0.290
1-5	14(58.33)	10(55.55)			
5-10	3(12.5)	5(27.77)			
More than 10	4(16.66)	2(11.11)			
Average number of dispensing high alert medication per day					
1-5 drugs	6(25)	3(16.66)	3	0.82	0.842
6-10 drugs	8(33.33)	8(44.44)			
11-15 drugs	5(20.83)	3(16.66)			
More than 15 drugs	5(20.83)	3(16.66)			
Average time for patient counselling for each patient					
Less than one minute	2(8.33)	1(5.55)	3	4.86	0.181
1-5 minutes	19(79.16)	10(55.55)			
6 to 10 minutes	3(12.5)	5(27.77)			
More than 10 minutes	0	2(11.11)			
Number of pharmacists in your pharmacy usually review the drugs before dispensing					
None	1(4.16)	1(5.55)	3	0.89	0.825
One	12(50)	6(33.33)			
Two	8(33.33)	7(38.88)			
More than Two	3(12.5)	3(16.66)			
Inventory control duration					
Daily	13(54.16)	1(5.55)	3	13.06	**0.004**
Once in a week	6(25)	5(27.77)			
Twice in a week	2(8.33)	7(38.88)			
Once in a month	3(12.5)	5(27.77)			

$\chi 2$ – Chi-square statistics on distribution of categorical variable; **$p < 0.05$** in bold letters was considered as statistically significant

prescription had more than 10 drugs in ADDs and this difference was found to be statistically significant (p= 0.013). In ADDs, 54% of pharmacists reported that the inventory control takes place daily which was statistically (p=0.004) higher than the TDDs (5.55%). Meanwhile, the average number of prescription errors monitored per day and dispensing high alert medication per day has no significant difference between ADDs and TDDs. Similarly, there is no statistical significance between ADDs and TDDs regarding the average time for patient counselling for each patient and the number of pharmacists reviewing the prescription before dispensing.

Pharmacists perception on ADDS and TDDS

The validated 5-point Likert scale questionnaire (Part III) was used to compare the pharmacist's perception regarding the aspects of the dispensing system (questions 1,2 and 3), dispensing practice (questions 4,5,6,7 and 8) and patient education (questions 9 and 10) between ADDs and TDDs (Table 6). The mean values of pharmacist's perception between ADDs and TDDs were compared by using the independent student 't' test. According to the mean (SD) score, the pharmacists in ADDs believed the system supports their skills and is safe to the patient than TDDs; however, this difference has no statistical

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Table 6. Pharmacists perception of ADDS and TDDS

No	Questions	ADDS (24) n (%)						TDDS (18) n (%)						t	p value
		Strongly Agree (5)	**Agree (4)**	**Neutral (3)**	**Disagree (2)**	**Strongly Disagree (1)**	**Mean (SD)**	**Strongly Agree (5)**	**Agree (4)**	**Neutral (3)**	**Disagree (2)**	**Strongly Disagree (1)**	**Mean (SD)**		
1	Do you feel your dispensing system adopted in your pharmacy supports your skill?	6 (25)	9 (37.5)	7 (29.16)	2 (8.33)	0	3.79 (0.93)	3 (16.66)	9(50)	3 (16.66)	0	3 (16.66)	3.50 (1.29)	0.850	0.400
2	Is the dispensing system in your pharmacy considered safe to the patient?	12 (50)	6 (25)	5 (20.83)	1 (4.16)	0	4.20 (0.93)	2 (11.11)	10 (55.55)	6 (33.33)	0	0	3.77 (0.64)	1.679	0.101
3	Is the dispensing system in your pharmacy need to be changed in your hospital?	10 (41.66)	2 (8.33)	7 (29.16)	5 (20.83)	0	3.70 (1.23)	6 (33.33)	7 (38.88)	4 (22.22)	1 (5.55)	0	3.94 (1.05)	0.652	0.518
4	Do you have sufficient time to review (check for prescription error) for each prescription?	9 (37.5)	7 (29.16)	6 (25)	2 (8.33)	0	3.95 (0.99)	3 (16.66)	11 (61.11)	4 (22.22)	0	0	3.94 (0.64)	0.052	0.959
5	Do you have sufficient time to dispense each prescription?	11 (45.83)	8 (33.33)	2 (8.33)	3 (12.5)	0	4.12 (1.03)	2 (11.11)	10 (55.55)	6 (33.33)	0	0	3.77 (0.646	1.250	0.218
6	Do you have sufficient time to label each prescription?	11 (45.83)	9 (37.5)	2 (8.33)	2 (8.33)	0	4.20 (0.93)	1 (5.55)	11 (61.11)	6 (33.33)	0	0	3.72 (0.57)	1.950	0.058
7	Do you have sufficient time to review the medications before dispensing?	12 (50)	8 (33.33)	3 (12.5)	1 (4.16)	0	**4.29 (0.85)**	2 (11.11)	10 (55.55)	5 (27.77)	0	1 (5.55)	**3.66 (0.90)**	**2.278**	**0.028**
8	Do you have sufficient time for inventory control (maintenance of stock) in your pharmacy?	7 (29.16)	6 (25)	7 (29.16)	4 (16.66)	0	3.66 (1.90)	4 (22.22)	7 (38.88)	7 (38.88)	0	0	3.83 (0.78)	0.55	0.586
9	Do you have sufficient time to answer the patient questions?	10 (41.66)	10 (41.66)	1 (4.16)	2 (8.33)	1 (4.16)	4.08 (1.10)	3 (16.66)	8 (44.44)	7 (38.88)	0	0	3.77 (0.73)	1.020	0.314
10	Do you have sufficient time for patient medication counseling?	10 (41.66)	5 (20.83)	6 (25)	3 (12.5)	1 (4.16)	3.91 (1.10)	5 (27.77)	6 (33.33)	7 (38.88)	0	0	3.88 (0.83)	0.090	0.929

Independent student ‘t’ test; mean (SD) between ADDs and TDDs; **p<0.05** in bold letters was considered as statistically significant

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significance. The mean (SD) value of TDDs in question 3 was 3.94 (1.05) greater than the pharmacist's perception of ADDs [3.70 (1.23)] which implies that the pharmacists in TDDs recommended to changing their dispensing system to the ADDs.

In the patient education factor, the mean score was higher in ADDs than TDDs with regard to the appropriate time for answering patient questions and patient medication counseling; however, this difference was not statistically significant. In dispensing practice, there was no significant difference between ADDs and TDDs regarding reviewing the prescription. Conversely, the pharmacists practicing in ADDs (Mean score 4.29) mostly felt that they have sufficient time to review the medication before dispensing it to the patient compared with TDDs (Mean score 3.66). This difference was found to be statistically significant (p=0.028). The pharmacists agreed that ADDs enabled sufficient time for drug dispensing (79.16%) and labeling (83.33%) than TDDs but the difference in mean scores was not statistically significant. The mean score was higher regarding inventory control in TDDs; however, it has no statistical significant difference with ADDs.

DISCUSSION

To the best of our knowledge, this study is the first to validate, a 10-items Likert scale questionnaire to address the pharmacist perceptions of ADDs and TDDs. According to the statistical analysis, the pharmacists had similar perceptions regarding the dispensing system, dispensing practice and patient education in both ADDs and TDDs, except for reviewing the medications before dispensing. In our study, most of the pharmacists in ADDs (83.33%) agreed that they had significantly enough time to review the medications before dispensing compared with (66.6%) using TDDs. Therefore, time saving while dispensing could shift the pharmacist work from technical service towards optimization of drug therapy and improving patient safety.[35] Utilizing the automated dispensing system, the percentage of hospitals where a pharmacist review and verify prescription orders before a medicine is available for administration to a patient has markedly increased in 2017.[36] The study findings revealed no significant difference in the prescription errors detected per day between ADDs and TDDs. Both hospitals included in our study adopted the Computerized Physician Order Entry (CPOE) system; however, pharmacists detected a reasonable percentage of prescription errors irrespective of the dispensing system. The incidence of prescription errors in CPOE is multifactorial and must be carefully intervened by pharmacists.[35] Although the pharmacists demonstrated higher rate of satisfaction with ADDs to regarding ease of use, speed and safety,[37] the dispensing error in ADDs was still higher in Saudi Arabia.[38] The factors that contribute to dispensing errors are yet to be established.[39,40] The capacity of ADDs to reduce adverse drug events due to medication error remains controversial because of the lack of powered studies reporting clinically relevant outcomes.[41,42] Therefore, this study proposes that future longitudinal studies are required to ensure the role of ADDs in reducing medication errors and its consequences like adverse drug events and patient safety.

Interestingly, a higher percentage of pharmacists (61.1%) in TDDs were satisfied with their inventory control system. Meanwhile, a significantly higher number of pharmacists in ADDs reported that they perform daily inventory control activity compared with 5.55% of pharmacists using TDDs. This finding was consistent with the previous report that inventory control management is still problematic in ADDs and need improvement.[37] The average time for dispensing each prescription has no significant difference between the two systems statistically; however, almost 75% of pharmacists spent less time (within five minutes) in prescription filling using ADDs as compared with TDDs (55.55%). The majority of pharmacists (90%) took only up to 5 minutes to label the medications in ADDs, and this finding substantiates the previous report regarding the efficiency of ADDs in dispensing and labeling.[43]

In our study, the pharmacists had the opportunity to express their points of view regarding their dispensing system. Most pharmacists (75%) agreed that ADDs was safe for the patient and supported their skills (62.5%) of medication management; whereas, 71.33% of pharmacists in TDDs proposed to changing their dispensing system. However, the mean score between ADDs and TDDs has no statistical significant difference regarding pharmacist's perception. This study pioneered to compare the perceptions of pharmacists between ADDs and TDDs and we suggest that the pharmacists need to emphasize the importance of ADDs regarding the reduction in patient waiting time,[44,45] cost-effectiveness,[46,47] minimizing dispensing errors and improving patient safety[48] and focus towards clinical area rather than the technical aspects.[35]

Concerning patient education, although the higher proportions of pharmacists reported that ADDs enabled sufficient time for answering patient questions (83.32%) and patient counseling (62.49%); however, the mean score has no significant difference with TDDs. This may be because patient counseling is an integral part of the pharmacist role prior to medication dispensing regardless to the dispensing system. Patient education plays a major role in ensuring patient satisfaction with pharmacy care,[49,50] patient awareness and compliance with drugs and correct drug administration.[51]

Although the reduction in patient waiting time improves patient satisfaction, the previous studies warranted the positive effect of pharmacist freed-up time in ADDs.[52] In this context, the major finding in our study addressed that the pharmacist's freed-up time could be invested in reviewing the medications before dispensing could reduce the incidence of dispensing errors. ADDs facilitated the transition of the pharmacist role to medication therapy management that has resulted in moving their services from a central pharmacy to the patient care areas, and enabling monitoring patient response to therapy and improved patient outcomes.[40]

Limitations of the study

Pharmacists perception was compared between ADDs and TDDs, and there was a possible selection bias in the present study. Another limitation of the study was that it relied on staff self-reporting details of prescription error detection and high alert medication dispensing and not on data analysis of incident errors. Further, the limited sample size included in the study does not represent the perceptions of the larger pharmacist's community.

CONCLUSION

Automated drug dispensing is perceived as highly effective in improving the medication dispensing process, particularly in providing sufficient time for pharmacists to review the medications before dispensing. However, pharmacists need to emphasize the advantages of ADDs in reducing the prescription filling time, minimizing dispensing errors and enhancing patient counseling and satisfaction. The perception of pharmacists on ADDs needs to be investigated in every hospital and the positive impact of automated dispensing should be translated into perceivable benefits on better collaboration with physicians, review and approval of medication selection and patient safety.

DECLARATION OF CONFLICTS OF INTEREST

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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