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Original Article

Evaluation of pharmacy information system in teaching, private and social services Hospitals in 2011

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ABSTRACT

Objective: Supporting a therapeutic approach and medication therapy management, the pharmacy information system (PIS) acts as one of the pillars of hospital information system. This ensures that medication therapy is being supported with an optimal level of safety and quality similar to other treatments and services. **Materials and Methods:** The present study is an applied, cross-sectional study conducted on the PIS in use in selected hospitals. The research population included all users of PIS. The research sample is the same as the research population. The data collection instrument was the self-designed checklist developed from the guidelines of the American Society of Health System Pharmacists, Australia pharmaceutical Society and Therapeutic guidelines of the Drug Commission of the German Medical Association. The checklist validity was assessed by research supervisors and PIS users and pharmacists. **Findings:** The findings of this study were revealed that regarding the degree of meeting the standards given in the guidelines issued by the Society of Pharmacists, the highest rank in observing input standards belonged to Social Services hospitals with a mean score of 32.75. Although teaching hospitals gained the highest score both in process standards with a mean score of 29.15 and output standards with a mean score of 43.95, the private hospitals had the lowest mean score of 23.32, 17.78, 24.25 in input, process and output standards, respectively. **Conclusion:** Based on the findings, it can be claimed that the studied hospitals had a minimal compliance with the input, output and processing standards related to the PIS.

Key words: Clinical pharmacy information system, evaluation, information system, pharmacy

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INTRODUCTION

In general, the health system managers regard the performance of Pharmacy Department as the determining factor in the achievement of the health system in caring for patients safely and effectively.[1] Each beneficiary in the medication supply chain requires a reliable and standard system. This system must be such that enables them to define who may have access to what information, how this information can be used, validated and managed.[2] Health information system can be considered as a strategy useful for increasing the quality and safety of health-care system,[3] which provides physicians required information in the best way for evaluation

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and accountability.[4] Pharmacy information system (PIS) in hospitals as one of the main applications of information technology plays a significant role in investigating and validating all the policies and procedures related to medication use processes.[5,6] According to American Society of Health System Pharmacists, the hospital pharmacist plays an increasingly significant role in ensuring the positive results of medication therapy.[7] Decreasing the level of medication errors due to unreadable methods of transcriptions, drug administration and delivery, PIS makes the practitioners and professionals aware of the unsafe practices of the medication margins, overdoses and the potential interacting effects of prescribing two medications simultaneously.[8] Data banks related to the administered medication plans available in the PIS commonly include patient demographic and related drug interaction information.[9]

Some advantages that can be enumerated for PIS as an integrated information system include its significant effect on controlling medication interferences,[10] determining medication dosage based on laboratory results,[11] providing physicians informational needs after patient discharge,[12] decreasing medication costs[13,14] and reducing drug errors especially drugs preventable side effects.[9] Despite this, based on American Hospital Association estimation, medication errors contribute to 30.5% of the total sentinel medical errors.[15] Furthermore, according to the National Patient Safety Agencys (NPSA) report, the total number of medication errors in a period of 5 year from 2000 to 2004 has been 991 with the most frequent type of the error being related to the efficacy dosages (26.9%).

In addition, with respect to the total number of errors associated to the various dimensions of dosages, the highest rank belonged to overdosed medications (50.9%).[16] In a study, Martin (2006) showed that applying the technology of automated drug dispensing system, using smart infusion pumps, recording medications information clinically, bar coding of drugs, recording physician orders in computer and preparing electronic medical profiles had promoted the productivity of the hospital under study up to 65%, 53%, 29%, 29%, 27% and 43% respectively.[12] Alsultan *et al.* in their study found that 51.9% of the hospitals were equipped with the electronic system for recording the medications errors and reporting.[17] Danielson in his research found that speed, efficacy and users satisfaction are regarded as the considerable parameters of the system performance.[18]

Viewing the role of advanced technology and electronic prescribing as the highest parameter for justifying the preference of electronic PIS compared with the pharmacy manual activities[19,20] on one hand and the capabilities of the PIS in improving the quality and safety of services related to the medication provision, dispensing, maintenance and monitoring and the significance of information for the efficient and effective management of the pharmacy on the other hand this research has embarked upon the evaluation of this system based on the American, German and Australian Societies of Health system Pharmacists standards taking into account the informational components such as input, processing and output.

MATERIALS AND METHODS

This study is an applied, cross-sectional study. The research population included all users of PIS in selected hospitals. This system has been used in 10 public teaching hospitals (i.e. Shahid Beheshti as a medical-teaching Women and Labor hospital with 180 beds, Shahid Chamran as a heart Specialty hospital with 192 beds, Noor and Ali Asqar as general teaching hospitals with 275 beds, Imam Musa Kazem as a Burns and Accidents hospital with 120 beds, Isa Ibn Maryam as a general medical hospital with 261 beds, Al-zahra as a super specialty academic hospital with 950 beds, Ayatollah Kashani as a general medical-teaching hospital with 394 beds, Feiz as specialty eye medical-teaching hospital and ENT with 172 beds, Seyed Al-Shohada as an oncology hospital with 130 beds and Amin as a general hospital with 152 beds). This system was also found to be used by seven private hospitals (Kanevadeh general hospital with 60 beds, Saadi hospital with 120 beds, Sina hospital with 60 beds, Sepahan hospital with 120 beds, Isfahan hospital with 50beds, Mehregan hospital with 40 beds, Hazrat-e-Zahra-e-Marzieh hospital with 60 beds) and by two social services hospitals (i.e., Shariati hospital with 850 beds and Qarzi hospital with 256 beds) done. The instrument used to collect the data is a self-developed checklist containing 236 informational components which was created according to the guidelines issued by the Societies of Health System Pharmacists in America, Germany and Australia. Informational components including medication information, patient information (compliances' demographic, disease signs, progress trends, body performance medication use, medication allergy and interactions), medication prescriber information, medication purchase, inventory informational standards, i.e. input, process and output.[21-23] In addition focusing on the role of pharmacist, medication consultation and the importance of information in medication therapy process. The validity of the checklist was assessed based on reviews and the views gathered from the research supervisor conducting the present research, as well as the PIS user, computer experts, pharmacists and professors in the health information management field. The content validity checklist was confirmed using research literature and related documents. The researcher collected the required data through observation and the checklist, which was distributed in person to PIS pharmacists and users. The collected data were entered in to statistical package for the social sciences (SPSS) software, using descriptive statistics including frequency and relative frequency intervals. Applying the Kruskal Wallis and Wilcoxon non-parametric tests[24] the researcher tried to investigate to what extent the standards related to the input, processing and output components were met with respect to different types of the hospital (i.e. teaching, private and social services) and the

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type of PIS applied. Thereafter, the situation of the selected hospitals was analyzed and compared accordingly.

Visiting the hospitals in question in person, the researcher collected the required data through observation and the questionnaires, which was distributed in person to PIS pharmacists and users. After final control, the collected data were entered into the SPSS software. SPSS as a statistical software is used to describe and to analyze the gathered data. The data were analyzed using the descriptive statistics.

RESULTS AND DISCUSSION

Among the total number of hospitals in question (i.e., 10 teaching, 7 private and 2 social services hospitals), the PIS was of semi-automated type in 84.21% of the hospitals and of automated type in 15.79%.The medication inventory information system used in these hospitals was also found to be automated in 63.16% of the hospitals and manual in 36.84%.

Table 1 shows the comparison of the mean scores related to the level of compliance with the informational components i.e. input, output and process standards, among the hospitals under study indicated that there was no statistically significant difference between the hospitals in terms of meeting the input standards in their PIS ($P = 0.17$ and $\chi^2 = 3.46$). However, the process and output standards were found to be statistically different at the level of significance of 0.01 ($P = 0.03$ and $\chi^2 = 6.70$). To conduct the pair comparison of the hospitals regarding the process and output standards, Wilcoxon test was administered. This test results showed that there was statistically significant difference between teaching ($P = 0.01$, $Z = -2.39$) and private hospitals ($P = 0.01$, $Z = -2.49$) at the level of significance 0.05.

Table 1: Mean scores related to the degree of meeting input, process and output standards according to types of hospitals

Hospital	Input standards		Processing standards		Output standards	
	Mean score	Standard deviation	Mean score	Standard deviation	Mean score	Standard deviation
Teaching	29.68	8.94	26.15	6.79	43.95	10.86
Private	23.32	6.53	17.78	4.99	24.25	12.79
Social services	32.75	0.48	21	1.41	41.56	5.34

The level of observing the input, processing and output standards given by the Society of Health-System Pharmacists were also investigated in terms of the PIS applied in hospitals in question. The comparison of the mean scores has been presented in Table 2. Based on Kruskal-Wallis test results, it can be said that there was no statistically significant difference between the applied PISs in terms of the degree of meeting the input ($P = 0.62$, $\chi^2 = 5.28$), process ($P = 0.58$, $\chi^2 = 5.60$) and output standards ($P = 0.72$, $\chi^2 = 4.44$).

The results of the comparison of the mean scores related to the degree of observing the input, process and output standards of the PISs for teaching, private and social services hospitals in information system applied have been summarized in Tables 3-5. Among the teaching hospitals, the PIS applied in Noor and Ali Asqar hospitals gained the highest rank in observing the input with a mean score of 45.68% and process standard with a mean score of 34% while the PIS in Kashani hospital with a mean score of 58.72% enjoyed the highest rank as far as output standards were concerned. The PISs applied in the Imam Musa Kazem gained the least rank with the mean score of 18.96% in terms of input standards. Furthermore, the least mean scores in both observing process standards of (12.50%) and output standards (22.09%) found to belong to PIS applied in the Feiz hospital. Among the private hospitals under study, the PISs in Kaneveadeh Clinic and Sina hospital acquired the least rank in observing input with a mean score 12.93% and output with a mean score 4.65% and processing with a mean score of (12.50%), respectively.

Based on the study findings, it appears that regarding conforming to the input standards, the hospitals in question

Table 2: Mean scores related to the degree of compliance to the input, process and output standards for each individual hospital

PIS	Hospital					
	Input standards		Processing standards		Output standards	
	Mean score	SD	Mean score	SD	Mean score	SD
PIS/Al-zahra	25.51	0	19	0	39.53	0
PIS/Kashani and Feiz	30.86	11.21	22.25	13.78	41.27	27.13
PIS/Amin and Sepahan	32.27	8.53	19.25	1.76	35.46	13.97
PIS/Isfahan clinic	21.37	0	16	0	18.60	0
PIS/Seyed Al Shohada	29.82	0	27	0	47.09	0
PIS/Saadi Mehregan Sina and Zahra-e-Marzieh	25.43	6.09	19.12	6.45	30.23	11.85
PIS/Shariati and Qarazi	32.75	0.48	21	1.41	41.56	5.34
PIS/Noor-Aliasqar and Isa Ibn Maryam and Imam Musa Kazem and Chamran and Beheshti and Khanevadeh clinic	25.57	11.49	27.41	7.05	38.27	18.06

SD = Standard deviation, PIS = Pharmacy information system

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Table 3: Mean scores for meeting the input, processing and output standards in the PISs in terms of the teaching hospitals

Hospital	Input standards	Processing standards	Output standards
Noor and Ali Asqar	45.68	34	58.72
Isa Ibn Maryam	22.06	30	41.86
Imam Musa Kazem	18.96	26.50	38.37
Chamran	31.20	31.50	46.51
Beheshti	22.58	28.50	39.53
Al-Zahra	25.51	19	39.53
Kashani	38.79	32	60.46
Feiz	22.93	12.50	22.09
Seyyed Al-Shohada	29.82	27	47.09
Amin	39.31	20.50	45.34
Total	29.68	26.15	43.95

PISs = Pharmacy information systems

Table 4: Mean scores for meeting the input, processing and output standards in PISs in terms of the private hospitals

Hospital	Input standards	Processing standards	Output standards
Kanevadeh clinic	12.93	14	4.65
Sepahan	27.24	18	25.58
Saadi	27.06	18	30.23
Mehregan	21.72	18	18.60
Sina	19.65	12.50	25.58
Zahra-e-Marzieh	32.27	28	4.51
Isfahan clinic	21.37	16	18.61
Total	23.32	17.78	24.25

PISs=Pharmacy information systems

Table 5: Mean scores for meeting the input, processing and output standards in the PISs in terms of the social services hospitals

Hospital	Input standards	Processing standards	Output standards
Shariati	32.41	20	45.35
Qarazi	33.1	22	37.79
Total	32.75	21	41.56

PISs = Pharmacy information systems

with a maximum mean score of 14.50 are very far from the desirable condition. The input standards itself is composed of a number of informational components namely registration of information related to the medication (including usage patterns, pharmacodynamic and pharmacokinetics properties, drug allergies and drug interactions, dosage, etc.), access to patients demographic information, access to patients' claims information, signs and progress course of the illness, patient's treatment information, records of drug prescriber's information, records of the purchase control information and drug inventory, information about observing the standards, instructions and guidelines on documentation and exchange of information in the PIS.

It is noteworthy that currently the administrative managers informational requirements play a critical role in whether executing a PIS will be successful or not. Hence, due to attention must be paid to these requirements.

The results of the present study are in line with Ursula study titled "Pharmacy services to England's Emergency Departments in 2010." This study revealed that just 40% of the medication information requirements are recorded in the PIS in the form of description. This provides some evidence that the potential functions of the system in supporting the management of medication-related complications and order writing skills on hand and decreasing drug interactions and managing medication inventory on the other, have been ignored.[25]

With respect to processing standards, acquiring a maximum mean score of 12.95, the hospitals seemed to be far from the desirable condition (i.e., 100).

However, the accurate calculation of the dosage is one of the primary elements of medication therapy to reach the desirable result.[9]

Unfortunately, the scope of the applications of the PIS in the selected hospitals was just limited to the calculation of the costs and quantity of the medications dispensed to the patient. The significance of PIS potential capacities becomes clear when we review the results of John Nazzaros study on the pharmacies equipped with computerized systems in Navel hospitals in Charleston (1983) in a period of 2 years. This study illuminated that by providing the opportunity to calculate the medication dosage for the out-patients, computerized systems have led to the promotion of productivity of the pharmacy in such a way that concurrent with an 18% increase in work load, there was a decrease of 14% in staffing.[26] In another study carried out in the state of Arizona in (2007), Mallon *et al.* reached findings similar to those of the present research. In their study investigating the pharmacies from different perspectives including workload, use of technology in prescription, processing drug interaction warnings and the viewpoints of the pharmacists regarding the medication interactions by not using software (81.1%) pharmacies were not able to follow the drug interaction problems.[27]

As far as the level of conforming to the output standards is concerned, the results revealed a maximum mean score of 12.90, which indicates that hospitals in our study are again far from the optimal condition, i.e. 100. PIS should also be used for creating different reports related to the pharmacy performance including the following:

1. Daily reports related to dispensing the controlled medications based on dispensing location
2. Reports related to the required medications to be purchased
3. Reports related to medication inventory
4. Reports related to medication prices
5. Reports related to annual performance of the pharmacy
6. Reports related to the financial status of the pharmacy and finally

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7. Reports related to the medications inventory at the end of the year.[9]

PIS also plays an increasingly large role in providing both physicians and other care providers or the patient at the time of his/her discharge with a report of medication therapy he/she has received, which shall be useful for continuing the treatment course. Another research carried out in this regard, by Paul's (2009) is worth-noting that all patients after being discharged have experienced some difficulties in relation to the medications they needed after discharge. These difficulties mainly relate to the quantity or the type of required medications resulting from several medication changes during stay time. For the treatment and control group under study, the rate of medication contradictions at the time of discharge found to be 33.5% and 59.6%, respectively.[28] Hence, regarding the prolific research carried out on the modern technologies and taking into account the role of PIS in health-care domain, this fact becomes clear that rather than merely a technical system, this system must be regarded as a clinical system too.

PIS plays a key role in decreasing the errors, increasing the speed and facilitating the processes from three discrete perspectives including managing the optimal medication services (supply, maintenance and distribution), optimal financial management (costs, profits and investments), Scientific support to medication therapy including calculating, medication dosage accuracy, preventing drugs potential interactions, predicting drug-allergies and controlling side-effects of the prescribed drugs.

Contrary to this, the findings of the present research revealed that in hospitals in question the use of PIS as a component of Hospital Information System was just restricted to the managerial and financial aspects of medication services processes without having any role in the medication related scientific or usage dimensions.

As a result, PIS's advantage in reducing medication errors remains untouched. From the analysis of the results, it can also be inferred that PISs applied in the selected hospitals not only have failed to satisfy their key role in promoting the treatment process and decreasing the medication errors, but also quite contrary to the expectations, each has varied performance. This condition can be attributed to inattention to the users' needs and what they expect from such systems and not giving them an opportunity to take part in administering this system on one hand and ignoring the role of pharmacists' clinical consultation beneficial in patients treatment.

Keeping these results in mind, it can be claimed that as an inevitable requirement of health-care system, Irans health system authorities must undertake to administer an integrated PIS throughout the country.

In summary, the findings of the present research showed that among the PIS in question, the PIS applied in social services hospitals and PIS in Amin and Sepahan hospitals gained the highest ranks in observing the input standards, while the highest mean score in meeting the standards related to processing and output standards belonged to Noor and Ali Asqar and Syyed Al-Shohada PIS$_s$, respectively.

It is worth noting that due to not paying attention to such system's capabilities, all hospitals suffer from some deficiencies that need to be obviated.

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