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Functional Requirements of Pharmacy Information Systems in Hospitals

Mehrdad Farzandipour, Zahra Meidani, Hossein Riazi, Monireh Sadeqi Jabali

Abstract —*This study was conducted with the aim of determining functional requirements of pharmacy Information Systems using questionnaires given to end-users. This research is a descriptive, cross-sectional one with an applied nature which was conducted through 15 hospitals in 2010. It was conducted in three independent steps including a library study, an internet search and a semi-structured guideline together with a questionnaire. Ten experts were provided with the findings of the semi-structured questionnaire. Also, 50 experts were provided with the final questionnaire designed using Delphi technique. The validity and reliability of the final questionnaire were confirmed through content validity and test re-test methods, respectively. Data were analyzed using SPSS software and answers were given points of 0-4 and requirements with a mean final point of 3 or higher were confirmed. Based on the first and second applications of Delphi technique, the final list of functional requirements of Pharmacy Information Systems for 80 requirements was determined. The highest mean point was shown to be related to 'making direct connection with computerized provider order entry' (3.73%), 'calculating drug dosage and warning about drug interference" (3.71%), 'apply barcode technology' (3.71%) and 'registering expiration date, way and place of keeping goods' (3.63%).based on experts' opinions, requirements related to patient security were paid more attention to. Finally, a list of functional requirements of pharmacy Information Systems was presented which could be used by designers, developers and other beneficiaries of pharmacy Information Systems in hospitals under study*[1].

Keywords: **Pharmacy Information System, Hospital Information System, Pharmacy, Functional Requirements.**

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I. INTRODUCTION

Patient security is among the highest priorities of the individuals employed in the drug profession. Medication errors are known as the most prevalent threat to patient security (1) which are prevalent in hospitals and which can be prevented (2). According to the medical association, each year, 400000 cases of preventable harms of the patients in the hospitals in United States of America are reported to be due to medication errors (1). Results of a study indicated that 6.5 unpleasant events resulted from medication observed among 100 admitted patients among which more than one-fourth had been reported to be preventable (3). The effect of medication errors on the quality of care and patient' security is a growing concern (4). The primary consequence of medication errors is increased hospitalization term, increased cost, serious harm and even death (5). It was reflected in the study of Hughes and Oritz (2005) that, in 30% of cases, patients experiencing medication errors die or become unable for more than six months (6). Regarding the frequency of medication errors and their effect on the quality of care and patient' security, it is necessary to do more research on the reasons behind these errors and propose some strategies for decreasing them (4). Among more serious medication errors, approximately one-third occur while writing orders, one-third during drug delivery and the remaining one-third in the phase of distributing drug and filling prescription (7). Al-Shara (2010) showed that 8.7% of medication errors had been related to drug distribution by pharmacies (8). In Toruner and Uysal's study (2009), nurses mentioned that 13.4% of the primary reasons for medication errors are related to sending wrong drugs and drug dosage from pharmacies (1). Hospital pharmacies present healthcare services by selecting, preparing, storing, compounding and distributing drugs and drug equipment (9) and these activities require retrieving, processing, comparing information and updating (10). Using information technology services is known as an encouraging strategy in preventing medication errors (9, 11, 12). Therefore, implementing an efficient, organized and secure drug-distributing system is necessary in order to control the cost and make sure that prescriptions are secure and occur at the time of request (13). Pharmacy's information system (PIS) is sub-system of hospital information system (14) that collects, stores and manages the information related to drugs and drug consumption in the process of patient care (15) and provides accurate and comprehensive information for patients, pharmacist, physicians, nurses and other health care providers as a response to drug requests (16). Activities of this system consisted of managing drug distribution, analyzing drug orders, presenting reports, providing patient's drug information, clinical surveillance through monitoring interference and drug allergy and management of pharmacies (15, 17-19). This system results in decreased errors related to incorrectly interpreting handwritten prescription, decreased errors related to drug distribution and controlling drug side effects (19, 20). Bates (2000) demonstrated that PIS can considerably reduce medication errors (9). Despite all these advantages, a research conducted by Collignon (2010) on pharmacy services in emergency wards of the UK showed that only 40% of medication requirements are being registered in PIS (21). Some studies have been also conducted in Iran in order to evaluate PIS; Emani and colleagues (2014) showed that the extent of conformity of hospitals' Information System was low in Shiraz University of Medical Scinces' hospital as far as the criteria of American College of Physicians concerning pharmacies is concerned (22). Saghaeinnejad Isfahani and colleagues (2013) showed that input, process and output criteria of Isfahan Pharmacists Association have not been completely observed in hospitals of Isfahan with maximum means of 32.75%, 43.95% and 26.15%, respectively (23). In a study conducted by Asadi and colleagues (2010) in educational and medical hospitals in association with Shahid Beheshti University, drug information, patient information and prescriber information were found to be registered improperly and incompletely in PIS with values of 50.1%, 21.9% and 33.3%, respectively (16). Farzandipur and colleagues (2010) demonstrated that hospital ISs in Iran do not appropriately meet the expectations of pharmacy staff with maximum conformity of 58.6% (24). These systems must be designed based on users' needs, aims, the support process and users' work procedure in order to ensure health information system tool success (25). Mc Alearnen (2014) mentioned focusing on the working process as one of the strategies for successflu information system (26) and Romano (1986) stated that functional requirements of the systems must be specified by users who use them (27). Therefore, pharmacists' cooperation and involvement in designing systems

through questionnaires regarding their needs and expectations are among the measurements that can be effective in developing systems in line with their working processes and their needs. Due to the importance of knowing users' expectations which could lead to designing more successful ISs and improving patient security and care quality based on clinical environment procedures, this study was conducted with the aim of determining functional requirements of PISs in a national scale.

II. METHODS

This research is a descriptive, cross-sectional one with an applied nature conducted in 2010. In the first step, a semi-produced guideline and a questionnaire were prepared through library studies. Pharmacy Information System Capabilities were listed in a semi-produced questionnaire and an open-ended question was added to the end through which experts were asked about what would be added to primary requirements in experts' opinion. In the second step of this study, the semi-produced guideline was e-mailed to 10 experts. Experts participating in this study included pharmacy technical chairmen of the hospitals under study. In the primary questionnaire, none of the PIS requirements were deleted and just some requirements were suggested by experts. After analyzing material content and concluding expert opinion, the final questionnaire of PIS requirements was designed in three parts including demographic information, 81 closed-ended questions and an open-ended question; demographic information was related to age, gender, field of education, level of education, employment, job experience, and the experience of working with PIS. Eighty-one closed-ended questions were agreed upon based on the criteria and requirements taken from library study and expert opinion presented in the first step of the study. Five-point Likert scale was the ranking criteria ranging from strongly agree to strongly disagree. An open-ended question was then added to the end of the questionnaire to collect other requirements considered important by the experts. The reliability and validity of the questionnaire were assessed and were shown to be acceptable. The validity of the questionnaire was specified based on content validity and expert opinion and its reliability was calculated as 0.93 seven days after re-sending the questionnaires to the experts. In the third step, since the final PIS users are technical chairmen, interior managers and technicians working in hospital pharmacies, 50 participants including technical chairmen, interior managers and technicians who had been interested in participating in the study and who had had at least two years of experience working with PISs were provided with the final version of the questionnaire. The experts were provided with these questionnaires handed to them in person in hospitals under study (15 randomly-selected hospitals in Isfahan and Tehran). Thirty-eight out of 50 questionnaires were filled in. Results were analyzed using SPSS software (18^{th} version). Answers including strongly disagree, disagree, no opinion, agree, and strongly agree were given 0, 1, 2, 3 and 4 points, respectively. The final mean point of each requirement was calculated. Requirements with the final mean point of 3 or higher were confirmed; requirements with final mean point of lower than 2 were deleted and requirements with final mean point of 2 to 3 were offered to experts for more analysis.

III. RESULTS

In this study, 63.2% of experts were females and 36.8% of them were males. The mean age of participants was 34.9±5.9 years and the minimum and maximum age of participants were 26 and 45 years, respectively. According to Table 1, most participants (57.9%) had B.A degrees and most of them had been employed contractually (50%). The man job experience of participants was 9±6.2 years. The mean duration of operating and implementing HISs in the hospitals under study was 4.2±1.57 years and the mean job experience of experts working with HISs was 3.7± 1.4 years.

Table 1. Demographic information of experts

variables		number	percentage
gender	male	14	36.8
	female	24	63.2
	total	38	100
level of education	B.A	22	57.9
	M.A	1	2.6
	Ph.D.	15	39.5
	total	38	100
kind of employment	formal	14	36.8
	provisional	4	10.5
	contractual	14	36.8
	other	6	15.8
	total	38	100

2. Functional requirements of pharmacy information systems

users' viewpoints / functional requirement	completely agree	agree	no comments	disagree	completely disagree	total	mean of score out of 4
1. defining the kind of pharmacy in terms of hospital admission (outpatients, hospitalization, outpatients and hospitalization)	(34.2)13	(57.9)22	(5.3)2	-	(2.6)1	(100)38	3.21
2. defining pharmacy, storage and stoke in an unlimited number	(34.2)13	(47.4)18	(10.5)4	(7.9)3	-	(100)38	3.07
3. specifying the kind of pharmacy in terms of admission, special location and surgery room with the possibility of setting calculation of all insured items at the time of registering prescriptions	(39.5)15	(55.3)21	(5.3)2	-	-	(100)38	3.34
4. defining different types of storage (such as medicinal storage, consumed goods, etc.)	(39.5)15	(57.9)22	(2.6)1	-	-	(100)38	3.36
5. registering expiration date, way and place of keeping goods	(65.8)25	(31.6)12	(2.6)1	-	-	(100)38	3.63
6. warning at the time of goods' expiration date	(65.8)25	(31.6)12	(2.6)1	-	-	(100)38	3.63
7. setting medicinal stoke of the ward based on drug expiration date and drug number	(42.1)16	(50)19	(7.9)3	-	-	(100)38	3.34
8. entering and calculating drugs and facilities consumed by patients in every shift and specifying drug stoke status and ward facilities	(50)19	(39.5)15	10.5)4	-		(100)38	3.39
9. setting the maximum inventory, order threshold and sale threshold for all pharmacies and stores for each good	(42.1)16	(44.7)17	10.5)4	(2.6)1	-	(100)38	3.26
10. displaying the inventory of each good in a real-time fashion in all pharmacies and stores of the hospital including selling and buying price, expiration date and availability	(48.4)18	(39.5)15	(7.9)3	-	(5.3)2	(100)38	3.28
11. displaying the inventory of each good which is not available in all pharmacies and stores of the hospital (zero point)	(44.7)17	(44.7)17	(5.3)2	(5.3)3	-	(100)38	3.28
12. warning about minimum inventory, order threshold and sale threshold for all pharmacies and stores at the time of registering documents and prescriptions	(36.88)14	(50)19	(10.5)4	2.61	-	(100)38	3.21
13. requesting for transmission among stores	(44.7)17	(36.8)14	(13.2)5	(5.3)2	-	(100)38	3.21
14. referring pharmacy requests to medicinal storage electronically after the technical manager has confirmed the request	(50)19	(36.8)14	(10.5)4	(2.6)1	-	(100)38	3.34
15. comparing storage and pharmacy inventory with the minimum stoke for each drug and warning in cases of minimum stoke inventory	(10.5)4	(10.5)4	(15.8)6	-	-	(100)38	3.26
16. stating lack of drug inventory in pharmacy and medicinal storage at the time of stating ward request for drugs	(60.5)23	(28.5)11	(10.5)4	-	-	(100)38	3.5
17. registering returned drugs	(47.4)18	(47.4)18	(2.6)1	(2.6)1	-	(100)38	3.39
18. coding drugs (e.g. NDC)	(34.2)13	(52.6)20	(13.2)5	-	-	(100)38	3.21
19. defining different varieties of drugs	(44.7)17	(44.7)17	(1.5)4	-	-	(100)38	3.34
20. defining different default texts in order to register drug consumption type (such as oral, injection, inhaler)	(39.5)15	(50)19	97.9)3	(2.6)1	-	(100)38	3.26
21. defining drug consumption type during pregnancy (A, B, C, D, X)	(42.1)16	(34.2)13	(18.4)17	(5.3)2	-	(100)38	3.13
22. defining the importance level of drug requests (little, stat or maintenance)	(36.8)14	(42.1)16	(15.8)16	(5.3)2	-	(100)38	3.1
23. defining patient gender in order to register prescription information (female, male)	(28.9)11	(44.7)17	(23.7)9	(2.6)1	-	(100)38	3
24. defining varieties of medicinal categorization (such as antibiotics, narcotics)	(47.4)18	(47.4)18	(2.6)1	(2.6)1	-	(100)38	3.39
25. defining varieties of item categorization (such as drugs, consumed facilities, cosmetics)	(39.5)15	(47.4)18	7.9)3	-	(5.3)2	(100)38	3.15
26. defining varieties of packaging with their coefficients in order to register number of goods	(42.1)16	(42.1)16	(7.9)3	(7.9)3	-	(100)38	3.18
27.registering and editing all needed medicinal and non-medicinal items of the hospital	(52.6)20	(34.2)13	10.5)4	(2.6)1	-	(100)38	3.36

28. organizing medicinal and facilities entries alphabetically	(50)19	(47.4)18	(2.6)1	-	-	(100)38	3.47
29. filtering of medicinal items entries based on searching parameters	(36.8)14	(52.6)20	(7.9)3	(2.6)1	-	(100)38	3.23
30. printing entries of medicinal and non-medicinal items	(47.4)18	47.4)18	(2.6)1	(2.6)1	-	(100)38	3.39
31. registering additional information of each drug categorically for future use	(44.7)18	(39.5)15	(13.2)15	(2.6)1	-	(100)38	3.26
32.registering medicinal side effects of drugs	(34.2)13	(55.3)21	(10.5)4	-	-	(100)38	3.23
33. managing drugs and facilities' entries through barcodes	(71.7)27	(26.3)10	(2.6)1	-	-	(100)38	3.68
34. managing filling prescriptions through barcodes	(37.7)28	(23.7)9	(2.6)1	-	-	(100)38	3.71
35. calculating drug dosage based on patients' medicinal history and physiological parameters and changing consumption units	(76.3)29	(18.4)7	(5.3)2	-	-	(100)38	3.71
36. recognizing and warning about any cases of non-conformity of prescribed drugs with the diagnosed disease and patient physiology	(65.8)25	(2101)8	10.5)4	(2.6)1	-	(100)38	3.5
37. making direct connection with computerized provider order entry	(73.7)28	(28.9)11	-	-	-	(100)38	3.73
38. diagnosing and warning about any of any drug-drug, drug-food, drug-allergy, drug-test results interference	(71.1)27	(28.9)11	-	-	-	(100)38	3.71
39. warning about any risks of the prescribed drug	(65.8)25	(31.6)12	(2.6)1	-	-	(100)38	3.63
40. accessing scientific sources such as review databases and medical studies	(55.3)21	(42.1)16	(2.6)1	-	-	(100)38	3.52
41. receiving requests and sending answers of medicinal counseling of different clinical wards electronically	(60.5)23	(31.6)12	(7.9)3	-	-	(100)38	3.55
42. supporting the danger management system confidentially and anonymously	(60.5)23	31.6)12	(5.3)2	-	-	(100)38	3.52
43. receiving and sending requested drug lists electronically by clinical wards	(60.5)23	(28.9)11	(10.5)4	-	-	(100)38	3.5
44. determining whether a drug is narcotic or not	(36.8)14	(47.4)18	(13.2)5	-	(2.6)1	(100)38	3.15
45. defining physicians' specialties	(36.8)14	(34.2)13	(26.3)10	(2.6)1	-	(100)38	3.05
46. defining the title of the physician who has prescribed medication	(26.3)10	(55.3)21	(15.8)6	(2.6)1	-	(100)38	3.05
47. defining authorized individuals who can sign for issuing delivering drug permission	(36.8)14	(55.3)21	(7.9)3	-	-	(100)38	3.28
48. defining the names of units authorized to issue delivering drug permission	(39.5)15	(47.4)18	(13.2)5	-	-	(100)38	3.26
49. defining verities of delivering drug permission	(36.8)14	(47.4)18	(15.8)6	-	-	(100)38	3.21
50. defining the names of contracting companies to register drug invoices	(42.1)16	(50)19	(5.3)2	(2.6)1	-	(100)38	3.31
51. registering ordering invoices and producer and manufacturer invoices and sending reports to the accounting unit	(31.6)12	(25.6)20	(15.8)6	-	-	(100)38	3.15
52. defining prescription rules for delivered or undelivered drugs including "to be prescribed by a special physician", "just for special patients", "rationing number and time interval between two prescriptions" (important for outpatients)	(39.5)15	(50)9	(7.9)3	(2.6)1	-	(100)38	3.26
53. warning and accurately examining prescription rules for delivered or undelivered drugs including "to be prescribed by a special physician", "just for special patients", "rationing number and time interval between two prescriptions" (important for outpatients)	(36.8)14	(50)9	(13.2)5	-	-	(100)38	3.23
54.capability to register characteristics of drug producers including characteristics of company, list of produced drug, dose, shape, and buying price of drug	(34.2)13	47.4)18	(18.4)7	-	-	(100)38	3.15
55. defining drug packages to accelerate selecting number of drugs for each document and prescription in an unlimited number with the capability to include barcodes	(28.9)11	(55.3)21	(10.5)4	(5.3)2	-	(100)38	3.07
56. defining several working groups in order to observe medicinal items separately (observing a number of drugs for some authorized users)	(31.6)12	(52.6)20	(10.5)4	(2.6)1	(2.6)1	(100)38	3.07
57. controlling patients' name and surname, health insurance card's expiration date, physician's name and surname and medical counsel number at prescription time	(39.5)15	(47.4)18	(13.2)5	-	-	(100)38	3.26

58.defining technical right titles (such as day prescription, night prescription, etc.)	(34.2)13	(52.6)20	(10.5)4	(2.6)1	-	(100)38	3.18
59. setting the technical right calculation of outpatients or hospitalization in franchise percentage for each insurance case	(36.8)14	(42.1)16	(18.4)7	-	(2.6)1	(100)38	3.1
60. defining contracting party insurance while registering outpatient and hospitalization franchise percentage and determining the maximum insurance in order to warn at time of registering patients' prescription	(42.1)16	(52.6)20	(6.3)2	-	(2.6)1	(100)38	3.36
61. determining maximum insurance for each specialty in order to warn at time of registering patients' prescription	(50)19	(47.4)18	(2.6)1	-	-	(100)38	3.47
62. editing insurance information of contracting parties	(36.8)14	(44.7)17	(15.8)6	(2.601	-	(100)38	3.15
63. defining an accepted shared price by insurance company based on outpatient prescriptions, hospitalization prescriptions and special prescriptions such as operation rooms	(39.5)15	(47.4)18	(13.2)5	-	-	(100)38	3.26
64. calculating the price which is accepted by insurance based on the price of goods mentioned in prescriptions	(44.7)18	(44.7)18	(5.3)2	(5.3)2	-	(100)38	3.28
65. printing the price of patients' prescriptions on their health insurance cards in order to be referred to insurer organizations.	(36.8)14	(50)19	(10.5)4	(2.6)1	-	(100)38	3.21
66. rounding off the cost of patients' portion in prescriptions	(28.9)11	(52.6)20	(10.5)4	(7.9)3	-	(100)38	3.02
67. registering OTC prescriptions (registering prescriptions without health insurance cards)	(47.4)18	(28.9)11	(18.4)7	(2.6)1	(2.6)1	(100)38	3.15
68. displaying messages in case of not applying insurance due to goods' limitation	(36.8)14	(39.5)15	(21.1)8	(2.6)1	-	(100)38	3.1
69. printing a detailed report of prescriptions in any needed numbers	(36.8)14	(47.4)18	(13.2)5	(2.6)1	-	(100)38	3.18
70. selecting the default insurance while registering prescriptions based on the last insurer selected	(31.6)12	(47.4)18	(15.8)6	(2.6)1	(2.6)1	(100)38	3.02
71. defining the acceptable number of drugs for each insurance company for each prescription in order to warn at time of registering prescriptions	(44.7)17	(36.8)14	(18.4)7	-	-	(100)38	3.26
72. having the option to select one insurance or selecting all insurances for covering a good	(34.2)13	(47.4)18	(18.4)7	-	-	(100)38	3.15
73. having the option to select one insurance or selecting all insurances for covering all items	(36.8)14	(44.7)18	(15.8)6	-	(2.6)1	(100)38	3.13
74. deleting one or all insurances to deselect an item from the insurance list	(36.8)14	(44.7)17	)21.1(18	(2.6)1	(2.6)1	(100)38	3.02
75. homogenizing the tariffs of contracting party insurances to cover a good	36.8)14	(44.7)17	(15.8)6	(2.6)1	-	(100)38	3.15
76. defining specialty limitations for the goods for covered insurances in order to warn at the time of registering patients' prescriptions	(34.2)13	(50)19	(15.8)6	-	-	(100)38	3.18
77. homogenizing one or few insurances or insurers based on specialty limitations						(100)38	3.05
78. homogenizing one insurance of a good with other insurances of that good based on specialty limitations	(31.6)12	(47.4)18	(18.4)7	-	-	(100)38	3.1
79. having sub-systems in order to introduce herbal and chemical domestic and international drugs including the name of drug, names of other drugs, shape and way of effecting, pharmacokinetic, case of consumption, consumption prohibitions, interference in test and any other side effects	(63.2)24	(21.1)8	(7.9)3	(7.9)3	-	100)38	3.39
80. defining varieties of medicinal exceptions for hospitalized patients, outpatients and patients with fewer than six hours of hospitalization	(63.2)24	(26.3)10	(10.5)4	-	-	100)38	3.52
81. dedicating tracking code to patients' prescriptions in order to ease nurses and secretaries' cooperation	(60.5)23	(34.2)13	(5.3)2	-	-	100)38	3.55

IV. DISCUSSION

The present study was conducted with the aim of determining of Pharmacy Information System requirements based on the opinions of the users of such systems. Based on the results of this study, it can be concluded that the requirements of 'using decision-support system in calculating drug dosage', 'warning about medicinal interaction', 'using barcode technology', 'making direct connection with computerized provider order entry' and 'registering expiration date, way and place of keeping goods' are among the most important requirements of PISs. This may be attributed to problems related to medication errors' frequency.

Based on the results, most the experts agreed with being able to calculate drug dosage based on medicinal histories and physiological parameters of patients and to have the ability to change usage units. A Study conducted on hospitalized patients showed that 60% of medication errors are related to making mistake in drug dosage or drug consumption period (28). Chertow and colleagues (2001) showed that using decision-support system results in a 13% decrease in inappropriate dosage and 24% decrease in inappropriate period of drug prescription (29). In other study, Teich and colleagues (2000) stated that using decision-support systems makes five kinds of progress in dosage and period of using prescribed drug (30). Evans and colleagues (1998) introduced an advanced decision-support system for prescribing antibiotics in which the extent of parameters such as function of patients' kidney, age and sensitivity of cultured organisms were being received and suggestions being presented about drugs and their dosage. Using this system resulted in a considerable decease in drugs' side effects, cost and treatment duration (31). Nazzaro and Beary (1983) demonstrated that having pharmacies equipped with computer systems could increase the efficiency of pharmacies by calculating the exact dosage of consumed drugs for outpatients and could decrease prescription preparation time by up to 20% (32). Wager (2005) considered controlling the dosage of prescribed drugs based on patients' age, weight, and other effective factors as capabilities of a PIS (33). Asadi and colleagues (1388) concluded that preparing medicinal histories of patients and calculating drug dosage were being conducted in 46.1% and 30.7% of PISs of Shahid Beheshti University of Medical Sciences' affiliated hospitals, respectively (16). Mistakes made concerning drug dosage are among the preventable prevalent medication errors (34, 35). Clinical decision–support systems could help to decrease PIS medical errors and specify secure drug dosage. This system can suggest secure drug dosage for patients by registering patients' characteristics such as weight, age, height, physiological and psychological parameters, comorbid diseases, consumed drugs and patients' reaction to those drugs.

Based on the results, most experts confirmed 'registering expiration date and way and place of keeping goods'. Results of functional assessment of PIS software in Iran confirmed that all under-study hospital Information System software do not make it possible to examine the requirement of managing drug inventory (36). Isfahani and colleagues (2011) believed that software existed in medical centers could not satisfy the needed expectations in terms of inventory management as one of the input, process and output criteria of pharmacist association (23). In PISs, keeping an interior inventory entry of all medicinal products can help to manage pharmacy's inventory. When drug quantity is less than the usual quantity, PIS warns about it and prepares an electronic request through which the medicinal product would be prepared in an appropriate quantity from a confirmed medicinal producer (17). Wager (2005) stated that inventory management for keeping correct entry of medicinal store's inventory is among PIS capabilities (33). As a result, it is suggested that these requirements be considered in designing systems in order to manage the inventories of pharmacies.

Based on the results, most experts had a positive view about the existence of the requirement of 'diagnosing and warning about medicinal interference in pharmacy information system'. Regarding PIS tasks, Brown (2006) stated that PIS is responsible for a series of medical decisions such as controlling the amount of drugs, controlling drug-drug, drug-food and test result-drug interference. This study showed that 5.6-23% of side effects are resulted from medicinal interference which could be controlled by PIS (37). Alipor and colleagues (1391) indicated that 73.3% of physicians confirmed the effect of Information Systems examining medicinal effects' interference on increasing patients' quality of care (38). Gharamaleki and colleagues (1390) demonstrated

that 95.4% of clinical specialists had a positive view about implementing electronic design of food-drug interference (39). PIS was first responsible for the financial management, data management. Some main activities of PIS in that period included preparing pharmacy's invoices, inventory management and preparing reports such as preparing a list of delivered drugs, preparing medicinal tags and patients histories. PIS was being still used for managerial activities, drug delivery and controlling drug consumption up to middle 1990s. Modern Information Systems are responsible for supporting many medical decisions such as controlling drug-drug, drug-food and test result-drug interference (16). Concerning the importance of medicinal interference, it is suggested that registering medicinal interference is paid more attention to in pharmacy information sub-systems in order to prevent medicinal interference. This could help to make correct decisions as far as drug prescription and supporting pharmacy's medical activities are concerened.

Most experts had positive views about 'managing inventory and equipment through barcodes' and 'managing filling prescriptions through barcodes'. Poon and colleagues (2006) demonstrated that applying barcode technology in pharmacies before sending drugs to patient care wards resulted in a 36% decrease in medication errors and a 63% decrease in drug side effects (40). Wager (2005) stated that using medicinal barcodes for controlling previous and current drugs is among the PIS capabilities (33). If all the drugs in pharmacy have barcodes, it is ensured that correct drugs with correct dosage and formulation are distributed and errors resulting from drug distribution are considerably decreased. Applying this technology would helpful to prevent PIS medication errors.

Based on the findings of the present study, most experts approved of the requirement of 'making direct connection with computerized provider order entry'. Results of a study showed that applying CPOE causes a 55% decrease in medication errors (34). Physicians may write wrong or imperfect order at the time of registering medicinal orders in which drug dosage, consumption method and consumption duration may be omitted. Moreover, additional errors such as illegible medicinal orders or non-standard expressions occur in drug prescription. CPOE is a reasonable way to eliminate such errors and guarantees that medicinal orders have been registered completely, legibly and standardly (34, 41). Lack of any relations between CPOE and PIS causes re-registering medicinal orders in PIS which may result in duplicated prescription (42). The advantage of such a link is that medicinal orders are sent to the pharmacy faster and drug-related errors with the same name are decreased (43).

V. CONCLUSIONS

PIS as one of the sub-systems of hospital information system plays an important role in decreasing errors and increasing prescription, distribution and medication management speed. Therefore, information needs, processes and procedures of users working with this system need to be given great attention while attempting to buy such systems. Results of this study indicated that those system requirements concerning patient security such as using barcode technology, being equipped with decision–support system in order to warn about medicinal interference, calculating correct drug dosage, computerized provider order entry and its relation with PIS are paid more attention to by users. PIS was first responsible for managerial activities, drug delivery and controlling consumption drug while it is expected that modern PISs take medical decisions, decreasing medication errors and patient security into consideration. As PISs are being continually designed and offered for sale, recognizing the requirements such systems could help to fulfill aims and considered advantages. Approved requirements in this study may be useful for designers, companies selling software and managers of medical–health centers specially hospitals and other beneficiaries of hospital information systems.

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