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Electronic Documentation of Clinical Pharmacy Interventions in Hospitals

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Additional information is available at the end of the chapter

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1. Introduction

The documentation of interventions by hospital pharmacists has been on-going for over three decades through various available means; with recent national surveys suggesting that the majority of hospital pharmacists continue to document their interventions on a daily basis.¹⁻⁵ Pharmacist intervention encompasses all activities relating to safe medication utilisation and optimising therapeutic outcomes for patients in conjunction with other health care professionals which ultimately improves patient management or therapy'.^{5,6}

The percentage of hospital pharmacists documenting and collecting data on a regular basis has been shown to vary from as high as 72% to 50% in various countries.¹⁻⁵ The specialty of individual pharmacist's clinical practice does not seem to significantly influence the number of documentation of interventions with 86% of intensive care pharmacists and 74% of various clinical specialties reported documenting their interventions on a daily basis.⁵ However, there seems to be significant differences in the number of documented interventions between clinical pharmacists with respect to the level of managerial responsibilities.^{5,7} Clinical pharmacists with managerial responsibilities have variable workloads, while those without have more time allocated to spend on rounds with the medical team, enabling them to document all of their interventions. In addition, the significant effect of education level of clinical pharmacists and the number of interventions documented has been previously published.⁷ Clinical pharmacists with postgraduate qualifications seem to document significantly more interventions than those without.⁷ This is not surprising that post doctorate pharmacists contribute more interventions due to their higher level of training, experience and confidence than those without a post graduate degree.

Various guidelines and suggestions, including recommendations made by the professional regulatory bodies have been published on pharmacists' interventions. The American Society of Health-System Pharmacist (ASHP) has recommended that, as integral members of the health care team, pharmacist must document the care they provide.⁸ The Practice and Quality

Improvement Directorate of the Royal Pharmaceutical Society (RPS) has provided guidance on when an intervention is of sufficient significance for it to be recorded; the contents of the records made; where the record should be made; how the records could be utilised to improve efficiency and safety; and the length of time the records need to be retained for.⁹

2. Benefits and outcomes of pharmacists' interventions

Various reasons have been given for the recording of interventions by the RPS; to ensure patient safety and improve the quality and continuity of care; to provide evidence of the additional value of the pharmacist professional input; to have an accurate record available for scrutiny where decisions could be challenged; and to provide an incident or near miss monitoring process as part of the an organisation's clinical governance framework. The RPS recommends that interventions should be made as soon as possible after the event has occurred as this would enable the recording of details to be more accurate. Further recommendations include the recording of interventions into the patient's medication records either manually or electronically and they should be used to ensure consistency and continuity of standards and for reflective learning within the pharmacy team.⁹

The benefits of pharmacists' interventions in improving patient care is already well established, with no evidence of harm done to the patients.¹⁰ The contribution made by pharmacists have not gone unnoticed and as a result was recognized as essential aspect in safe medication use. The close collaboration with the physician through participation in medical rounds has been suggested to improve medication safety and has been described as important.¹⁰ As a result, traditional dispensing part of the hospital clinical pharmacist's job has all but disappeared and has undergone a paradigm shift by working directly with patients through the multidisciplinary teams consisting of physicians, nurses and other allied health professionals.

The outcome of pharmacists interventions have led to a reduction in mortality rates, drug costs and length of hospital stay.¹¹⁻¹³ In addition, it has resulted in improvements in medication appropriateness, pharmacoeconomics, health-related quality of life, and patient satisfaction.¹⁴⁻¹⁷ Furthermore, these interventions have significantly reduced the number of drug interactions, medication errors, and adverse drug events.¹⁹⁻²³

The benefits of pharmacists' intervention have been exploited for the expansion of the clinical pharmacists scope of practice.¹⁴ New pharmacy positions such as technicians have been created to fill in for the technical duties of pharmacists as a result of the expanded role of clinical pharmacists.¹⁴ The end result has been a reported lower medication error rate as the number of clinical pharmacists increased per occupied bed.¹⁵

There are, however, discrepancies between consensus recommendations of intervention recording and documentation of such interventions.¹⁸ For this reason, various guidelines⁷⁻⁹ and suggestions have been published on the subject as outlined above. The controversy of whether near miss or other interventions that prevent significant harm to patients by hospital pharmacist should be documented in patients' hospital health records when making recommendations will not be discussed in this chapter. Since the majority of

hospitals have separate reporting systems under risk managements for near misses and adverse drug reactions this will be not be reviewed in this chapter rather pharmacy stand-alone systems for documentation purpose will be reviewed as this is the most popular way for documenting pharmacist interventions.

3. Methods of pharmacy interventions documentation - A global look

Various methods of documenting pharmacist interventions have been explored.²⁴⁻²⁷ Earlier systems of documentation interventions used manual recording on a paper-based form and later on moved to electronic versions when they became available. Interestingly, the paper based intervention documentation system is still the preferred system of documenting of pharmacist interventions in some countries as shown by the survey of New Zealand Hospitals in 2008 where 88% collected data on paper, the majority using pre-printed forms and some using notebooks. In other countries paper based intervention documentation system has been replaced by other systems, as shown in a survey of 433 US health Care centres where only 24% documented interventions manually on a paper form.

Clinical Pharmacist Intervention Form

Pharmacist : _____

Date: _____

Serial No: _____

Drug Related Problems (DRPs)	Type of Intervention (T)	Clinical Significance (S)		Expected Outcome (O)		Acceptance (A)
1- No indication for drug therapy 2- No drug order for medical condition 3- Inappropriate drug selection 4- Inappropriate dosage regimen a) dose b) frequency c) route d) rate 5- Prescribed drug not administered 6- Experiencing ADR's or S.E. 7. Experiencing drug interactions (DI's): a) drug drug interactions (DDIs) b) drug food interactions (DFIs) c) drug lab test interactions (DLTIs) 8- Miscellaneous	1- Pharmacokinetics 2- Pharmacotherapeutics 3- Drug Information 4- Miscellaneous	1- Potentially severe/ highly clinical significance 2- Important/serious /moderately clinically significance 3- Minor/low clinical significance	1- Cost savings only 2- Potential ADR's/ Toxicity prevented 3- Enhanced therapeutic effect	A Accepted MA Modified then Accepted R Rejected <u>N.B.</u> if MA or R specify: a) what was the reason? b) Was it reasonable?		
Pt. Account number and unit	Intervention	DRP #	T #	S #	O #	Acceptance
	Rx _____ Rec _____					a) _____ b) _____
	Rx _____ Rec _____					a) _____ b) _____
	Rx _____ Rec _____					a) _____ b) _____
	Rx _____ Rec _____					a) _____ b) _____

Figure 1. Paper based system for documenting pharmacist interventions.¹⁸

Nearly all of the pharmacist intervention documentations systems for recording pharmacist interventions are mostly designed in-house to meet the requirements of individual hospital's administrative data requirement. As a result, the pharmacist intervention documentation system varies from institution to institution due to different priorities of each individual institution as illustrated in tables 1 and 2 where surveys from two different countries suggest different priorities of the different institutions.^{3,5}

Type of intervention	% Respondents Documenting
Change/clarify medication order	92
Therapeutic duplication	84
Drug-drug interaction	81
Adverse drug reaction	76
Formulary conversion	75
Medication selection recommendation	73
Pharmacokinetic consult	73
Therapeutic substitution	68
Medication error	67
Drug or lab level	62
Drug-food interaction	58
Drug information response	57
Potential adverse drug event	57
Patient education	45
Parenteral nutrition consult	44
Drug-disease interaction	44
Disease management recommendation	43
Drug use guidelines	40
Medication use without indication	31
Drug-herbal interaction	26
Untreated indication for medication	20
Pharmaceutical care plan	19
Admission medication history	15
Attendance at medical rounds	12
Patient medical history	11
CPR response	10
Discharge plan	9
Other	5

Table 1. Type of pharmacist Interventions Documented in US health-systems pharmacy directors survey (n=433).⁵

In a survey of US health-systems pharmacy directors,⁵ the most common type of intervention documented were changing or clarifying medication order, therapeutic duplication and drug-drug interactions. Adverse drug reactions, formulary selection, medication selection and pharmacokinetic consultation were also frequently reported. Less frequently reported interventions were pharmaceutical care plans, Admission medication

history and patient medication history. Whereas the survey from New Zealand,³ free text of the intervention description was frequently reported in addition to the pharmacist identification. Less frequent documented interventions was cost savings and time spent on interventions.

Type of data	Number of hospitals collecting this data n (%)
Date of intervention	23 (96%)
Pharmacist's name/identification	21 (88%)
Place where intervention was made	21 (88%)
Classification of intervention	21 (88%)
Medication name	21 (88%)
Brief description of intervention (free text area)	21 (88%)
Patient NHI/identification	18 (75%)
Consultant name/identification	18 (75%)
Reason for making the intervention	15 (63%)
Severity/ranking of intervention	15 (63%)
Intervention accepted or declined by other health professional	13 (54%)
Time spent on intervention	12 (50%)
Effect on cost saving	8 (33%)
Drug class/therapeutic classification	6 (25%)

Table 2. Types of data collected by hospital pharmacies in the survey of New Zealand Hospitals.³

4. Challenges and drawbacks of current systems

The prevalence of in-house documentation systems has been the most significant drawback in terms of standardising and achieving consistency of recording of pharmacist interventions and eventually using the data as a bench mark for comparison of clinical pharmacist's contributions. This lack of standardisation of pharmacist intervention documentation has been the subject of much debate in the literature^{3,5,18,28} and some have proposed to have a standard classification system like the one prevalent for Adverse Drug Reaction template imposed by the regulatory authorities.^{3,5} This would make it much easier to collect meaningful statistics and comparisons be made with other centres as a bench mark for clinical pharmacy services.²⁸

In a survey of US health-systems pharmacy directors, 61% of the respondents reported dissatisfaction with their current documentation systems.⁵ Similar in the survey of New Zealand hospitals a large proportion of respondent believed that they had problems with their documentation systems.³ Some have suggested that collecting data on paper was very time consuming especially if transcribing the data to an electronic storage data base and proved difficult to document all interventions. Others have reported that collecting data on pre-printed forms was cumbersome and transcribing the data was time consuming.²⁷ Furthermore, it was difficult to precisely audit pharmacists' workload, determine the quality of interventions and calculate cost saving, in line with what others have reported.²⁴⁻²⁸

With the difficulties encountered with the paper based pharmaceutical care intervention form, the challenges faced by any administrator is to implement a system that is user friendly and capture the data that is required. Another challenge is to capture all information that was previously entered on paper, increase the data-entry speed, and modify the database to address specific needs that was identified by the end users. One major advantage of an electronic system is the ease with which it facilitates monthly and annual reporting for departmental quality assurance programs. Numerous articles have been published on electronic pharmacist intervention programs in the literature and most have focused on a main frame computer terminal based in the pharmacy department.²⁴⁻²⁸

5. The King Faisal Specialist Hospital's experience, a personal-perspective

We had faced similar problems with our paper based documentation systems as described above, and in an attempt to improve the documentation of pharmacist's intervention we successfully developed and implemented a computerised application program to facilitate the collection and analysis of the data. Prior to this, pharmaceutical care activities and clinical interventions were either not documented or inconsistently documented (see figure 2). Later, the multi-user PC version and the subsequent enhanced version, the web based application revealed an increase in the number of interventions done by individual pharmacist with more pharmacists participating in the interventions recording regularly. We were able to show that by keeping the intervention program simple and easy to use; the contributions of individuals not only increased but were consistent. Here we describe in detail how we managed to develop our in-house documentation systems which may assist others in making similar documentation systems.

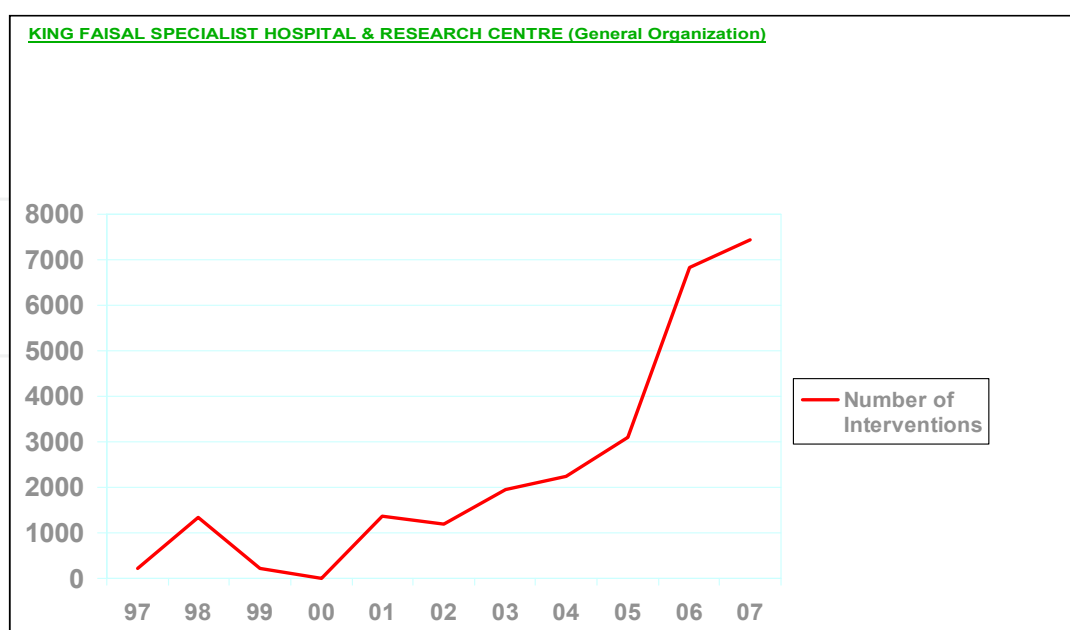


Figure 2. Clinical Pharmacist' interventions showing the trend from the paper based in 1997 to the multiuser PC (2004-2005) and finally up to the introduction of the web-based systems (2006-2007)- Unpublished Data (experience from KFSH&RC).

6. Process of documentation

6.1. The software

Traditionally two main types of electronic system of documenting of pharmacists interventions have been available to pharmacists for documentations of their interventions. One is the computer based pharmacist intervention program, multi-user PC version, restricted to a single point of entry in the pharmacy department or on the wards and the other a web based program such as based on Microsoft Visual Fox Pro® program Multi-user Application running under the Citrix® server using any terminal equipped with a Citrix® client.

Figure 3. Main screen of the multi-user PC software intervention form. Only one outcome could be documented at a time by the clinical pharmacist.⁷

The multi-user PC version provides a platform for easy manipulation, customization, and updating the paper based program. It allows the managers to monitor performance of individual pharmacists by evaluating the number of interventions made and the acceptance for daily interventions. In addition, it provides reports for the hospital administration on clinical pharmacists' activities and the data generated can be used to justify additional

clinical pharmacists' positions. However, the system requires installation of the software in individual stand-alone personal computers (PCs). With the limited numbers of PCs that could be accessed by the pharmacists at the point of need e.g. during the physician rounds and within the pharmacy department most often the clinical pharmacists have to record the interventions manually on paper intervention form on the physician rounds and later on record their interventions on the multi-user PC version, resulting in incomplete data collection and duplication of work which was time consuming.

From our experience,^{7, 18-19} the web based program of pharmacists' documentation systems facilitates ease of access and improves overall accuracy in data entry. The web based system enables the pharmacist to enter interventions from any workspace, in the clinic; on the ward; in the inpatient and outpatient dispensary. This may be achieved using any PC, laptop or even wireless personal digital assistant (PDA) connected to the hospital intranet. The ability to access the intervention program from any point is one major advantage of the web based intervention program. The web based application had one big advantage over the multi-user PC version since installation was not required in every PC and the program could be accessed from any location with intranet access. Since all in-patient areas and clinics were connected to the intranet, the easy access enabled the pharmacist to enter interventions from any workstation, in the clinics and on the ward during the physician rounds. This has been reflected in our recent study,⁷ where the use of the web-based application revealed a 40% increase in the total number of documented interventions compared to multi-user PC software. In addition the time required to document an intervention using the web-based application of 66.55 ± 8.98 s (mean \pm SD), is much quicker than documenting on paper base forms and as others have previously reported time of 81.8 ± 8.3 for web based program.^{7,29} As the majority of dissatisfaction with the pharmacy documentations systems was reported to be a lack of time the lack of pharmacist time,^{3, 5} the clinical pharmacist documentation system must be as efficient, and user-friendly as possible to be fully accepted by the end users and hence, be successfully implemented.

6.2. Intervention entry

Figure 4 depicts the "main intervention form" with the major categories e.g. Type of Intervention; Clinical Significance; Drug Related Problem; Acceptance; Expected Outcome clearly highlighted. It allows for the identification of the patient through the patient Medical Record Number (MRN), as well as the date and the location of the intervention. The pharmacist documenting the intervention is identifiable through the Drop-down pharmacists list which is password protected. The form further allows the pharmacist to document the main types of intervention inclusive of an intervention summary and the pharmacist recommendation. The web based program further enables the pharmacist to document cost saving only interventions on the main intervention form.

The cost saving interventions includes changes in dosage regimens, substitution with a less expensive drug, discontinuation of unnecessary drug and other indirect savings such as change from intravenous to oral formulation.

Figure 4. Main Data entry screen of the web based documentation application.⁷ Data entry screen for the patient demographic details of the web-based application with a mixture of drop down menus and free-text entry for comments. Free text entry must be kept to a minimum, in order to keep data entry simple and to improve the retrieval of information for reporting purposes. Patient's specific data *i.e.* Medical Record Number (MRN) and the intervention details were entered by free text.

7. Database construction and use

Ideally the use of free text entry should be kept to a minimum, in order to keep data entry simple and improve retrieval of information for reporting purposes. Patient's specific data *i.e.* Medical Record Number (MRN) can be entered by free text. The location and the intervention date can be entered using the drop down menus and radio buttons. The radio buttons are arranged in pre-determined groups of related options on the main data entry point based on our pharmaceutical care manual intervention form *i.e.* basic details, drug related problems, type of intervention, clinical significance, acceptance, and expected outcomes displayed on a screen as a list. Different types of clinical interventions were available under the tab of the type of intervention *i.e.* pharmacokinetics, pharmacotherapeutics, drug information, and miscellaneous.

8. Description of software

The construction of the database of the web based intervention program must take into consideration the feedback of the participating and non participating pharmacists, the departmental quality assurance pharmacist and the limitations of the multi-user PC version. The database must be designed to be user friendly with a multi-option of radio buttons, check boxes, and drop down menus. The free-text entry is to be kept at minimum for the descriptive nature of the interventions. The data entry must be user ID and password protected and the individual user documenting the intervention should be identifiable through their password which requires user authentication.

8.1. Data entry

The patients' number and location can be entered as free text. Using tab keys, allows the user to switch between different categories of interventions, basic details; drug related

problems; type of interventions; clinical significance; acceptance; and expected outcome. Activating the tab, done by a mouse click, make its associated content visible and the tab itself becomes highlighted to distinguish it from other inactive tabs. Only one tab must be activated at a time and the user cannot continue to the next step if there was missing details in the intervention form. Minimal manual data entry was required for documentations of interventions, with only the detail of the interventions done by free text.

Figure 5. Data-entry screen for drug related problems of the web based documentation application.⁷

The user selects the type of intervention using radio buttons and only one selection could be activated at a time. The selection of a radio button is done by clicking the mouse on the button, or the caption, or by using a keyboard shortcut. It was not possible to leave any of the radio buttons in a group unselected, as the user would not be allowed to move to the next screen.

8.2. Validation of pharmacy intervention documentation

The reliability and validity of pharmacist intervention data documented has been questioned by some and have highlighted the lack of consistency in categorising interventions.¹⁸ The lack of reliability in the individual pharmacist coding of interventions should be of concern especially if there is a lack of the reliability of the data generated. In order to standardise the intervention data, we defined three main types of interventions, which was highlighted when the user placed the cursor on the icon; Potentially Severe / High was defined as an intervention that may have resulted in decreasing patient mortality, preventing or reducing organ damage or system failure, and resulted in cost savings; Important / Moderate intervention was defined as an intervention that may have resulted in improving the quality of patient care; and Minor / Low interventions was defined as an intervention that may have resulted in improving convenience of compliance. This allowed

the user to enter the correct category as the definitions of the interventions were readily available (figure 6).

Figure 6. Data-entry screen for clinical significance of the web based documentation application.⁷

The cursor highlights the definition of the intervention when it is placed on the icon, thereby ensuring consistency in the data that is collected.

8.3. Documentation of cost savings

Inaccurate cost savings projections and the difficulty in making accurate cost savings projections have been cited as one of the major shortcomings in pharmacist intervention documentation systems in the surveys of US health systems pharmacy directors and New Zealand hospital pharmacies. In these surveys only 27% of US health-systems pharmacists and 33% of New Zealand pharmacists documented cost savings interventions. Although cost saving interventions was not specifically mentioned in the recommendations posted by the professional or regulatory bodies on documenting pharmacist interventions, they easily justify their inclusion in the clinical pharmacist's documentation system. In addition to justifying the hiring of additional clinical pharmacists, cost savings information helps emphasize the critical role of pharmacy in managing hospital drug budgets. These costs have risen dramatically in the recent years and continue to climb, which has resulted in pressure from hospital administrators to contain these costs. Taken together, consideration of the cost savings that result from clinical pharmacist interventions is an important factor in modern clinical practice. With the ever increasing cost of medications and pressure from hospital administrators, the impact of clinical pharmacist on cost savings could be emphasised to the senior hospital administrators.²³

Clinical Interventions - Help

MRN Location Intervention Date

Basic Details | Drug Related Problems | Type Of Intervention | Clinical Significance | Acceptance | **Expected Outcome**

☒ Cost Saving

☐ D/C unnecessary drug

☐ Change dosage regimen

☐ Change to less expensive drug

☐ Indirect cost saving

Estimated Saving (SR)

Calculate Saving ☒

	Search for Drug	Select drug from list	UOM	Price (SR)	Dose (Based on UOM)	Frequency	Duration (Days)
Current Drug	VORIC	VORICONAZOLE POWDER FOR INJ 200MG VIAL	VIAL	318.75	1	2	5
		22378 - VORICONAZOLE POWDER FOR INJ 200MG VIAL					
Recommended Drug	VORI	VORICONAZOLE TAB 200 MG	TABLET	82.5	1	2	3
		22378 - VORICONAZOLE TAB 200MG					
Saving Value		-2692.50	Calculate				

☐ ADR / Toxicity Prevented / Resolved

☐ Enhanced Therapeutic Effect

☐ Improve Compliance / Ease of Administration

Save | Verify & Save | Reset | Cancel

Figure 7. Data-entry screens for cost savings of the web-based documentation application.⁷ After the user selects the cost saving, specific data fields are made available that allow for the accurate reporting of cost savings using the software. The medications are pre-populated in the application. The software allows for cumulative cost savings to be calculated at the end of each financial year for each individual pharmacist.

However, the documented cost savings on drugs represent only a fraction of total cost savings as other indirect cost savings such as decreased hospital length of stay, reduction in the pharmacy and/or nursing time (e.g. switching from IV to oral medications) was not captured by our intervention program. Nevertheless, the significant sums of money involved are a justification for its inclusion in the pharmacist intervention program which was not included in the RPSGB guidance on recording of interventions. Cost savings interventions made by the pharmacists can be used to justify additional clinical pharmacist positions while emphasising the role played by the pharmacy department in managing the hospital drugs budget with the hospital administration.

9. How to use these records

The ease with which monthly or periodical reports are generated is one advantage of the web-based system. The system enables one to run monthly or periodical statistics on all interventions entered in the system. The generation of the clinical intervention reports may be utilised by the departmental managers during the annual staff appraisal and more importantly in the departmental quality assurance programs. The monthly or the periodical reports generated further ensure consistency and continuity in interventions standards. Moreover, junior pharmacists and pharmacy residents working in the department can utilise the data as a technical aid for documenting interventions. The underutilisation of the reports generated has been routinely mentioned by most hospitals and some have suggested that the reports must be shared with the medical and nursing staff through the various committees such as drug utilisation committee, quality improvement committee, senior hospital management and pharmacy and therapeutics committee.⁵

	Multiuser PC software		Web-based application	
Drug Related Problems	Number	Percentage	Number	Percentage
No Indication for drug therapy	245	4.97	523	7.65
No order for medical condition	295	5.99	642	9.39
Inappropriate drug selection	113	2.29	256	3.74
Inappropriate dosage regimen	1326	26.92	1756	25.67
Prescribed drug not administered	2	0.04	8	0.12
Potential/Actual (ADR/Allergy/Toxicity)	211	4.28	518	7.57
Potential/Actual Drug Interaction (DI)	46	0.93	517	7.56
Miscellaneous	1988	40.36	2536	37.08
Not Documented*	700	14.21	0	0
Type of Intervention	Number	Percentage	Number	Percentage
Pharmacokinetics	1273	25.84	1250	18.27
Pharmacotherapeutics	2483	50.41	5341	78.08
Drug Information	775	15.73	157	2.30
Miscellaneous	203	4.12	92	1.35
Not Documented*	192	3.90	0	0
Clinical Significance	Number	Percentage	Number	Percentage
Potentially Severe / High	337	6.84	830	12.13
Important / Moderate	3186	64.68	5495	80.34
Minor / Low	449	9.11	515	7.53
Not Documented	954	19.37	0	0
Acceptance	Number	Percentage	Number	Percentage
Accepted	4398	89.28	6288	91.93
Modified then accepted	144	2.92	178	2.60
Denied	135	2.74	150	2.19
Unknown	114	2.31	224	3.27
Not Documented*	135	2.74	0	0
Expected Outcome	Number	Percentage	Number	Percentage
Cost Saving	234	4.75	1988	29.06
- D/C unnecessary drug	344	6.98	1208	61.44
- Change dosage regimen	129	2.62	547	27.82
- Change to less expensive drug	13	0.26	109	5.54
- Indirect cost saving	23	0.47	124	6.23
Enhanced therapeutic effect	1581	32.10	3163	46.24
ADR / Toxicity prevented / resolved	2197	44.60	2628	38.42
Not Documented*	405	8.22	0	0
Interventions cost savings	132,937.99 SR (\$35,347.00)		228,786.93 SR (\$61,000.00)	
Total Interventions	4926		6840	

*The web-based application does not allow users to continue to the next screen unless all fields are completed thereby ensuring completeness and accuracy of the data collected.

Table 3. Clinical Interventions Report.⁷ Percentages are based upon the total number of interventions.

9.1. The use of mobile devices in clinical pharmacy documentation

The utilization of informatics and information technology in health care systems in the developed country is a common practice nowadays. This has ranged from informatics systems used for direct patient care to documentation of this care to those for billing and coding requirements. Mobile Personal Digital Assistants (PDAs) and now Smart Phones (SPs) and Tablet computers (TCs) e.g iPads, have the capability, power and technology needed to run such informatics systems for health care professionals who are in constant need for instant communication. Previous studies have outlined the usefulness of these mobile devices in data collection and documentation of clinical activity by health care providers.^{5,35-38} Currently used methods of documentation depend on standalone systems that are usually equipped with online access capability. Many hospitals in North America and Europe use online documentation forms hosted on their intranet that can be accessed via mobile devices equipped with wireless or cellular (3G or 4G) connectivity. The hypothesis is that this will facilitate access and eventually improve documentation.³⁵⁻³⁸

There are different platforms of mobile devices which employ similar applications from different manufacturers. Main platforms available in the market up until the writing of this chapter include those from Google, Inc. (Android based), Apple, Inc. (IOS based), Research in Motion (RIM), Inc. (BlackBerry based), and Microsoft, Inc. (Windows Phone based).

There has been an increased utilization of this technology for documenting pharmacists' interventions over the last few years. An earlier study in 2003 found that only 15% of surveyed hospitals used computerized tools for pharmacists' interventions documentation and only 5% of those hospitals used a mobile device technology.⁵ Other reports have shown a rapid increase in adopting this technology. Another study showed up to 54% of pharmacy interventions in a single hospital were recorded via mobile devices.³⁸

Advantages of using mobile devices in documenting pharmacists' interventions include more flexibility, speed and completeness. One study evaluated the completeness and speed of documentation using mobile devices compared to manual method and found out that captured fields of a single documentation was 96% vs. 86% in PDAs technology and traditional paper method; respectively.³⁸ More interventions were recorded in 3-10 minutes in the PDAs group compared to traditional paper method. The study concluded that the use of PDA technology was more complete and efficient than the traditional method.³⁸

There are several challenges for implementation and adoption of mobile devices for documentation purposes. These include but are not limited to cost of implementation and maintenance, security of transmission, and acceptance by pharmacy practitioners. Cost of such electronic means of documentation includes hardware, software, maintenance fees and pharmacist time. In one report, the annual cost of maintaining such system was up to US 5,000 not including pharmacist time.⁵

Securing the confidentiality of transmitting patient sensitive data is of paramount importance and this has been a challenge to most hospitals. Several developed countries have legislation in existence that mandate protection of patient personal information. Both

Canada and the United States have passed the Personal Information Protection and Electronic Documents Act and the Health Insurance Portability and Accountability Act (HIPAA); respectively. Both require certain measures to ensure that only authorized users can access these devices/systems. It is recommended that data encryption and access control be implemented to protect patient information stored on these systems.³⁹⁻⁴⁰

9.1.1. Personal perspective

Our successful experience with the implementation of the web based system of monitoring pharmacist interventions has led us to move forward to adopt a more easily accessible electronic documentation method; Mobile devices. Our plan, unlike previously reported methods is to focus on utilizing an online documentation application hosted on our intranet that can be accessed via mobile devices equipped with wireless connectivity. We hypothesize that this will facilitate access and eventually improve documentation.

We also plan to develop an Android and iOS based applications that will be installed on variety of mobile devices (Android phones and tablets and iPhones and iPads). This will allow users to enter data in both passive mode (off-line) and active (on-Line) modes. Currently, all of our hospital facilities are equipped with wireless hotspots (WiFi 802.11n standard) that provide 100% wireless coverage. The currently used online software will be re-written with web support to suite mobile devices. We plan to have a real-time synchronization with the clinical intervention server hosted in our Information Technology (IT) department. We also plan to have the client installed on the Smart Phones and iPads to manually synchronize with the server once the devices connects to our intranet. This will allow clinicians to manually synchronize data in case of unavailability of wireless coverage.

9.2. Pharmacy data mining

Data mining in pharmacy encompasses many functions which utilize technology that gives pharmacists the ability to analyse the huge amount of data related to drugs and their clinical. By definition these functions allow pharmacists to convert the raw data into meaningful information to guide best decision making.⁴¹ In the near past, pharmacy computer systems were standalone and closed by design. They were not integrated with other health information systems that contain important patient data e.g. laboratory, pathology, radiology, nursing and physician documentations. Over the last decade, the concept of having an integrated clinical information system has been adopted by many health care systems. This has led to an enormous increase in the amount and complexity of data that necessitated a sophisticated data warehouse or data repository. The clinical data repository collects, organizes and integrates pieces of data into what is known as data cubes or data marts. In pharmacy, these data cubes contain patient demographics, medication orders, physicians' and nurses' notes, laboratory results, and pharmacy interventions.⁴¹

Because of the nature and complexity of pharmacy data, clinical repositories need to be "mined" in a systematic and logical manner. To achieve the best results, these data

warehouses need to be secure, easily accessible, able to capture historical and real-time data, and capable of capturing population specific data to allow identification of management and clinically oriented trends for the pharmacy department and the whole organization. Once fully integrated, the benefits of clinical repositories extend to include enhanced communication between care-givers, and improved daily patient care.

Several clinical repository tools exist in the market. These include but are not limited to MicroStrategies (<http://www.microstrategy.com/>), Cognos (<http://www.cognos.com/>), Business Objects (<http://www.businessobjects.com/>) and Brio Technology (<http://www.brio.com/>). These tools are designed to enable directors of pharmacy, clinical pharmacy coordinators and other pharmacy informatics specialists to populate and analyse the raw data to yield meaningful clinical and managerial information to guide day to day operation in addition to other strategic decisions.⁴¹

Over the past few years, mining pharmacy data to monitor prescribing patterns and enhance revenues of insurance companies has been widely utilized in the United States. It is estimated that one billion prescriptions per year is being mined in the US alone based on one report². More than 51,000 retail pharmacies in the United States participate in data mining through 2 major data mining companies. This has resulted in significant revenues to the data miners that exceed \$2 billion annually.⁴² Despite the clear value of mining pharmacy data (clinically and financially), there has been some controversy over the past few years on the legality of pharmacy data mining.^{42,43} Despite that data miners remove patient identifiers, several states have banned pharmacy data mining because of claims that it invades prescribers' privacy and that it violates the Health Insurance Portability and Accountability Act (HIPAA). Several lower courts have ruled that pharmacy data mining is unconstitutional, however, recently the supreme court has decided that it is in fact constitutional.⁴²⁻⁴⁴

In early 2000s, we created a data warehouse at our institution as one of the first organizations to do so in the Middle East. We currently utilize IBM Cognos Enterprise as our data warehouse and performance management tool. After the successful implementation of our Integrated Clinical System (ICIS) in 2010, we planned to design and create different pharmacy reports from this data warehouse that include work load statistics at the user level, automated score card, Medication Utilization Evaluations (MUEs), turn-around time for inpatient and outpatient prescriptions and discharge medications, prescription trends, and prescription variances.

10. Summary

The accurate and precise documentation of interventions should be seen as a barometer of pharmacist activities and it is beyond any reasonable doubt that the clinical pharmacy documentation in hospitals has made a significant impact not only amongst the hospital administrators but also amongst the medical and nursing fraternity. However, there is still room for much improvement of the documentations. Since the recording of clinical

pharmacists' interventions is not mandatory in most of the institutions but it is highly recommended with little punitive action for those not recording their interventions. This non-punitive policy generally results in only a few dedicated pharmacists' documenting the interventions on a regular basis, whilst others documented infrequently and some do not participate at all. Numerous reasons have been cited for the non-participation in the recording of interventions and the repetitive nature of the program was the main reason for the non-adherence. The majority see it as a tool for gathering statistics and time consuming. However, those institutions that have incorporated the clinical pharmacist documentation into the annual evaluations of clinical staff pharmacists have observed an increase in the number of interventions documented. This in turn gives the pharmacy administration the justification required to approve additional FTEs and/or resources for their institutions. In addition, the impact of technology on pharmacist documentation program is best described again by the increase in the documentation of clinical pharmacy services, resulting in an increase the number of clinical pharmacists. So as long as pharmacists keep documenting their interventions and the technology keeps on improving through the hand held devices or even through the use of smart phones by making the process easier and faster their role as safe custodian of medications usage should be enshrined in law.

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