Clinical Audit of Pharmaceutical Care provided by a Clinical Pharmacist in Cardiology and Infectious Disease in-patients at the Royal Hospital, Muscat/Oman

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Abstract

Objectives: To characterise the pharmaceutical care provided by a clinical pharmacists working in a tertiary health care institute, where the extent to which the pharmacist contributes to changes in prescribing patterns use of medications, and patient knowledge was described.

Methods: A retrospective single cohort study design was used. Qualitative and quantitative evaluation of a documented pharmaceutical care plan was undertaken. Electronic pharmaceutical care descriptor (Microsoft Access® database) was used for analysis. 167 patients [mean age of 53 yrs, 70% male] from a Medical Health Centre in a tertiary hospital where a clinical pharmacist had provided a medication review. The study patients were those who had either been admitted to cardiology or infectious disease wards.

Results: There were 291 pharmaceutical care issues [PCIs; mean per patient (2)] comprising of 67% (n=194) relating to treatment monitoring and 33% (n=97) relating to treatment changes, representing a total of 291 drug therapy problems [DTPs; mean per patient (2)]. The resolution rate of DTPs was 70%, where 61% of recommended changes and 75% of recommended monitoring were implemented.

Conclusion: The clinical pharmacist successfully addressed most PCIs while attending ward rounds, reviewing in-patient prescriptions and counselling discharged patients. The electronic pharmaceutical care plan was very effective in recording the pharmacist's ward activities and the pharmaceutical care provided. However, further studies are required in order to explore long-term clinical pharmacists in-put using a well established electronic care plan; part of Al-Shifa computer system in Omani health centres.

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Introduction

Pharmacist role in cardiology and infectious disease

Since the beginning of clinical pharmacy, pharmacists have always specialized in cardiology pharmacotherapy. The need for close therapeutic monitoring made the roles of pharmacists in the care of patients with heart disease essential, where cardiac drugs tend to be complicated with the expansion in the number of drugs, cost, drug interactions, and narrow therapeutic margins. Patients with cardiac diseases tend to take medications for life. Pharmacists are ideally placed to promote safe, effective and economic medicine use.[1, 2]

Literature shows that pharmacists have improved the antimicrobial therapy process by narrowing the spectrum of therapy based on culture and susceptibility reports, therapeutic drug monitoring (TDM) of aminoglycosides resulting in more serum concentrations within the therapeutic range reducing nephrotoxicity, and by intravenous-to-oral dosage form conversion of antimicrobials which reduces cost and length of admission without adversely effecting the quality of care.[3,4]

Electronic pharmaceutical care plan

At the Royal Hospital (RH), the clinical pharmacist provides pharmaceutical care to patients assigned under cardiology/ infectious disease specialties.[5,6] While computerized hospital systems ensure all patient data is electronically saved. The absence of an electronic pharmaceutical care plan results in one of the essential icons of patient care not being properly documented, which has long-term consequences. This study aims to describe the pharmacist's role in providing pharmaceutical care for patients admitted under those specialties, and to examine the suitability and acceptability of care models involving an electronic pharmaceutical care plan.

Methods

Study design

This was a retrospective single cohort study design, where qualitative and quantitative evaluation of pharmaceutical care plan was undertaken.

Subjects and settings

This study was carried out at a Tertiary Medical Health Centre

(Royal Hospital, Muscat, Oman), where a clinical pharmacist provided pharmaceutical care by attending consultant rounds, performing medication review, and providing patient counseling prior to discharge for 3 months (March, April, May-2008).

The data was collected from pharmaceutical care profiles and patients' electronic medical files.

Patients admitted to cardiology and infectious disease wards who had a pharmaceutical care plan in place were eligible for inclusion in the study. No selection took place on basis of age, past medical history or any other criterion.

In total, 167 patients were identified, 90 patients from cardiology and 77 patients from infectious disease wards.

The data was analysed between the 15th of November and the 15th of December 2008. This date was chosen as the cut-off date for all the samples. Any new recordings of laboratory results or any changes in medications were not considered beyond the mentioned date.

Patients were identified by a manual search of the pharmacist pharmaceutical care plan. All patients admitted in cardiology and infectious disease wards who had a pharmaceutical care plan in place were included in the study. Patients were characterised by means of standard deviation of age, gender, and current complaints.

The data (pharmaceutical care activities and drug therapy problems) was manually transferred from the pharmaceutical care plans into a Microsoft Access database and Pharmaceutical Care Descriptor system (PCD) developed by the University of Strathclyde, UK, and modified by the Royal Hospital in Oman. Drug Therapy Problems (DTP) that lead to pharmaceutical care issues were identified, categorised and recorded as actual or potential problems. Pharmaceutical care activity was categorised as either checks (therapy monitoring), or changes (therapy adjustments) according to the PCD. Checks and changes were also recorded (see tables 1-4). The information was coded within the Microsoft Access database and retrieved using a variety of queries.

In order to demonstrate the nature of pharmacist ward activities in the selected areas (cardiology/infectious disease), ward activities were categorized as, patients seen in ward rounds, electronic prescriptions reviewed/verified, and discharge prescriptions reviewed, patient counseling. The frequency of occurrence for each type of activity was reported as a percentage (%).

The database was used to determine the total number of pharmaceutical care issues identified by the clinical pharmacist. The data was further analysed to determine which drug classes were associated with the highest rate of drug therapy problems.

Table 1: Sample table format of categories of pharmaceutical care issue

Pharmaceutical Care Issue	Checks (CK)	Changes (CG)

Table 2: Categorization of checks (Therapy Monitoring)

Check	Code
Medication needs inquiry	CK1
Effectiveness inquiry	CK2
Safety inquiry	CK3
Compliance inquiry	CK4
Formulary adherence inquiry	CK5
CK: Checks	

Table 3: Categorization of changes (Therapy Adjustment):

Changes	Code
Drug history	1
Drug selection	2
Daily dose increase	3
Daily dose decrease	4
Route/dose form	5
Interval/timing/ duration	6
Precautions/interactions	7
Patient Compliance	8
PCD between Health Centers	9
PCD: Pharmaceutical Care Descriptor	

Table 4: Categorization of Drug Therapy Problems (DTP)

	Code	
DTP	Actual	Potential
Unnecessary drug therapy	S1	?S1
Additional drug therapy needed	S 2	?S 2
Inappropriate drug	S 3	?S 3
Dosage too low	S 4	?S 4
Adverse drug reaction	S 5	?S 5
Dosage too high	S 6	?S 6
Non-compliance (therapy)	S 7	?S 7
Non-compliance (lifestyle)	S7-L	?S7-L

Results

Patient characteristics

The demographics of the study population were compiled using the database to summarize the gender mix, average age, and current complaints. In all 167 patients, the mean age was 53 yrs (SD: 18.9), and 70% were male. 90 patients (54%) were admitted

with cardiac diseases in the coronary care unit, and 77 patients (46%) with infections in adult medical wards. Diabetes mellitus was documented in 24 patients (8%).

Pharmaceutical care issues

During the three month study period, almost all the patients (n= 151; 90%) were seen by the pharmacist during consultant ward rounds, more than two thirds (n=115; 69%) of in-patient's prescriptions were reviewed via electronic medical notes, and almost half (80; 49%) of study group's discharged prescriptions were reviewed and patient counseling sessions were carried out. However, there were 291 pharmaceutical care issues [PCIs; mean per patient (2)]; comprising of 67% (n=194) relating to therapy monitoring, and 33% (n=97) relating to therapy changes, representing a total of 291 drug therapy problems [mean per patient (2)]. The resolution rate of DTPs was 70%, where 61% of recommended changes and 75% of recommended monitoring were implemented. (see tables 5-9).

Table 5. Most commonly prescribed drug classes (according to BNF body systems categorisation) ranked according to the highest rate of *DTP in 167 patients

Body System	DPT			Resolved
	Number of DTP	Actual DTP	Potential DTP	
Cardiovascular system	168 (58%)	49	118	117 (70%)
Infections	61 (21%)	16	45	52 (85%)
Endocrine system	24 (8%)	11	13	2 (8%)
Gastrointestinal system	14 (5%)	9	5	13 (93%)
Central nervous system	3 (1%)	2	1	2 (67%)
Miscellaneous	21 (7%)	9	12	18 (86%)

DTP: Drug Therapy Problem

There were three drug classes (cardiovascular, infections, and endocrinology) associated with highest rate of DTP (table 5). There were 168 (58%) DTPs with cardiovascular drugs, 61 (21%) with infectious disease medications, and 24 (8%) DTPs associated with endocrinology drugs. The resolution rate of DTPs associated with infectious disease medications was 85% (n= 52), while the resolution rate for DTPs associated with cardiovascular medications was 70%. There was a very low resolution rate for DTPs associated with endocrine system (8%, n= 2), mainly due to poor glucose control in acutely ill patients.

DTPs associated with medication indication (untreated indication, unnecessary drug therapy) accounted for 160 (55%) of the total DTPs (table 6).

Table 6: Drug therapy problems (actual or potential) distribution and frequency amongst 167 patients leading to a pharmaceutical care issue

Drug therapy problem	Number *DTPs
Untreated indication	150 (90%)
Actual	35
Potential	115
**ADR	37 (53%)
Actual	12
Potential	25

Table 6: Drug therapy problems (actual or potential) distribution and frequency amongst 167 patients leading to a pharmaceutical care issue.

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Drug therapy problem	Number *DTPs
Inappropriate drug	32 (%)
Actual	13
Potential	19
Compliance	28 (%)
Actual	09
Potential	19
Dose too low	20 (%)
Actual	09
Potential	11
Dose too high	14 (%)
Actual	10
Potential	4
Unnecessary drug use	10 (%)
Actual	8
Potential	2
Total	**291 (100%)**
Actual	96 (33%)
Potential	195 (67%)

DTP: Drug Therapy Problem; ADR: Adverse Drug Reaction

DTP_S, associated with medication effectiveness (dose too low & inappropriate drug) accounted for 52 (18%) of the total DTPs. DTP associated with safety (ADR & dose too high) accounted for 18% (51) of the total DTPs, and DTPs associated with compliance were the lowest detected (n=28; 10%).

There were 97 (33%) changes, which were implemented where change in medication (drug selection, dose increase/decrease, route/dose form, dose interval/ timing/ duration) represented 91% (n=88) of the total changes (table 7). This included 62 (64%) of changes falling into the category of "drug selection" (cessation or addition of a drug), while 18 (19%) changes (increase or decrease) were in dosage. On the other hand, there were 8 (8%) changes in patient factors/education (Patient comprehension, Patient agreement and participation). Overall, 59 (61%) of cases were resolved in total.

Table 7: Distribution and frequency of all changes recommended by clinical pharmacist (n=167 patients; 97 changes)

Type of Change	Total No. of Changes	Resolved
Drug selection	62 (64%)	35 (57%)
Daily (total) dose decrease	10 (10%)	4 (40%)
Daily (total) dose increase	8 (8%)	4 (50%)
Patient agreement/participation	8 (8%)	8 (100%)
Route/dose form	4 (4%)	3 (75%)
Dose interval/timing/duration	3 (3%)	3 (100%)
Drug history	1 (1%)	1 (100%)
Drug use precautions	1 (1%)	1 (100%)
Total	97 (100%)	59 (61%)

Around half of the total number of checks were recorded (table 8) these included medication needs inquiry (n=99; 51%), and one quarter of the checks were on effectiveness inquiry (n=41; 21%), while safety inquiries accounted for 19% (n=36), and compliance inquiries were the lowest recorded (n=18; 9%).

Table 8: Distribution and frequency of all checks identified by clinical pharmacist (n=167 patients; 194 checks)

Type of check	Number (%)
Medication needs inquiry	99 (51%)
Effectiveness inquiry	41 (21%)
Safety inquiry	36 (19%)
Compliance inquiry	18 (9%)
Total	194 (100%)

Table 9: Pharmacist Ward Activities during 3 months

Pharmacist ward activity	Number (%)
Patients seen in ward rounds	151 (44%)
Prescription reviewed/verified	115 (33%)
Discharge Rx review/counselling	80 (23%)
Total	346 (100%)

Pharmacist wards activities

In total, 346 activities were carried out, where almost all patients (n= 151; 90%) were seen during ward rounds, more than two thirds (n= 115; 69%) of patients' prescriptions were reviewed via the electronic medical notes, and almost half (80; 49%) of the study population's discharged prescriptions were reviewed and patient counseling sessions were carried out.

Discussion

This study was a single retrospective cohort study where pharmaceutical care provided by a clinical pharmacist was reviewed under the provision of pharmaceutical care by a clinical pharmacist. The care model used by the pharmacist involved the following:

- Screening and reviewing patients' electronic medical records to ensure safe and effective treatment.
- Attending consultant rounds.
- Developing a pharmaceutical management plan.
- Interviewing patients to collect information about the patient's knowledge of their medications, compliance, and how they respond to the treatment.
- Confirmation of drug histories.
- Patient counseling and education about medication and adverse effects.
- Therapeutic drug monitoring/ pharmacokinetic advice for relevant drugs.
- Recommendation for monitoring activities (checks) or changes in the treatment regimen, to reach specific therapeutic goals.
- Follow-up checks and changes to ensure implementations.

Patient Characteristics

The studied group had a mean age of 53 years (SD: 18.9). Characteristics of the patient group under study highlighted the relevant factors such as co-morbidities and key drug therapy on admission. 70% of the study population were males. This may be explained by higher epidemiology of cardiac diseases in males. Also; HIV infection in Omani society is more epidemiologic in males than females.

Shyam et al, conducted a study at the College of Medicine and Health Sciences, Sultan Qaboos University, and found that coronary heart disease contributes to approximately 10 per cent of all deaths of adults aged between 45 to 60 and 31% of those above 60. The study concluded that in the Omani population, hypertension, diabetes and dyslipidaemia are major risk factors leading to mortality and morbidity due to heart and vascular diseases.[7] In 2005, there were 2,798 patients (10%) admitted at the RH with cardiovascular diseases, and 447 patients (1.5%) with diabetes[8].

According to World Health Organization (WHO) statistics; the prevalence of HIV infection remains low in Oman. The estimated number of adults and children living with HIV/AIDS at the end of 2003 was around 1300 cases, where females represent around 30% of the cases. Among all cases reported between 1997-2001, 41% were from heterosexual transmission, 11% in men who have sex with men (MSM), 22% from blood products, 6% from mother to child transmission, 2% other modes, and 17% unknown[9].

The most common co-morbidities were reflected in the most common drug classes associated with DTPs, where cardiovascular drugs (58%), infectious disease (21%), and endocrinology (8%) were associated with the highest rate of DTPs. In view of complex medical conditions and the use of multiple long-term drug therapy make this group of patients at high risk of DTPs, and it is apparent that there is need for a pharmacist to review the patients.[10]

Pharmaceutical Care Issues

Pharmaceutical care is the responsible provision of drug therapy for the purpose of achieving definite outcome that improves patients' quality of life.[11] Pharmaceutical care involves the process of identifying potential and actual drug related problems, resolving actual drug related problems and preventing drug related problems.[11] This study describes the nature of pharmaceutical care activities provided by the pharmacist, and highlights the contribution made to the reduction of DTPs.

Previous literature showed that pharmacist medicine use review clearly helps to resolve DTPs, particularly those related to patient information needs, dosage, prescription problems, and monitoring to prevent adverse drug reactions.[12] In this study, there was a total of 291 PCIs identified by the clinical pharmacist, representing a mean number of 2 care issues per patient, which is slightly lower than what other studies have reported. This may be explained by the difference in settings and the difference in the age of studies among the population. Other studies showed 2.5 DTPs per patient with a resolution rate of 66%.[13-15] This study demonstrated a higher rate of resolution for PCIs, where the number of PCIs totally resolved was 70%, 61% included recommended changes and 75% were recommended monitoring implemented.

Interestingly, other studies found that DTPs associated with compliance were the highest (35%). Whereas in this study, DTPs associated with medication indication were the most frequent (n= 160; 55%), while DTPs associated with compliance were the lowest (n= 28; 10%). DTPs associated with medication effectiveness was the second highest in this study (n=52; 18%). It is acknowledged from previous studies in this field that regular review of patients on long term drug treatment is important but is done infrequently.[15-19] In the care model used in this study, a second review by the pharmacist post patient discharge was not usually undertaken, therefore making it more difficult for the pharmacist to identify actual compliance problems.

The three drug classes (cardiovascular, infections, and endocrinology) associated with highest rate of DTP are highlited in table 6. The findings of cardiovascular drugs associated with the highest rate of PCIs are consistent with what other studies have found.[12] In addition; those studies did not classify patients according to reasons for admission while this study did (cardiac/ infection patients).

Pharmacist Wards Activities

This study was designed to describe the general activities carried out by the pharmacist at the ward level in the way of providing systematic pharmaceutical care, and developing a complete care plan. Table 9 shows the unequal number of patients seen in each activity. In total, 346 activities were carried out, which is more than the number of patients (n=167) included in the study. This is due to some patients being seen more than once by the pharmacist, where almost all patients (n=151; 90%) were seen in ward rounds, more than two thirds (n=115; 69%) of patient's prescriptions were reviewed via the electronic medical notes, and almost half (80; 49%) of study population's discharged prescriptions were reviewed and patient counseling was carried out . For example; a patient was seen in the ward round, then in-patient prescription will be reviewed as a follow-up, and finally; the patient would be counseled on discharge, which means that three activities were recorded for one patient.

Study Limitations

The study examined current pharmaceutical care models in Omani Tertiary Health Centre in order to define the pharmacist's role in in-patients with cardiac/infection diseases and to examine the suitability and acceptability of an electronic pharmaceutical care plan. The study was carried out at the Royal Hospital in Muscat. However, patients were selected from two specialties only

(cardiology and infectious disease wards), and the pharmaceutical care provided was solely the effort of one clinical pharmacist.

The study was retrospective and relied on the qualitative and quantitative evaluation of pharmaceutical care plan by one pharmacist, who was the care provider and the researcher at the same time. The absence of an independent researcher to agree in the application of the Pharmaceutical Care Descriptor system to each pharmaceutical care activity and drug therapy problem was a limitation, and therefore cannot rule out bias in such applications.

The evaluation of the data with respect to the reduction of cost or reduction in hospital admission was out of the scope for this study. Also, the evaluation of clinical significance of the pharmacist's interventions was not applied.

Conclusion

The clinical pharmacist successfully addressed most PCIs while attending ward rounds, reviewing in-patient prescriptions, and counselling discharged patients. Electronic pharmaceutical care plan was very effective in recording the pharmacist's ward activities and pharmaceutical care provided.

However, further studies are required in order to explore long-term clinical pharmacist's in-put using a well-established electronic care plan (part of Al-Shifa computer system in Omani health centres).

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References

1. McGlynn S, Reid F, McAnaw J, Chinwong S, Hudson S. Pharmaceutical care; coronary heart disease. The Pharmaceutical Journal 2000; 265:194-205.
2. Williams H, Stevens M. Heart disease (2) Chronic stable angina. The Pharmaceutical Journal 2002; 269: 363-365.
3. Mcginnes M, Mcglynn S, Watson A. Identification of the pharmaceutical needs of patients with heart failure. International Journal of pharmacy practice 2001; 9:80.
4. Strand L, Morely P, Cipolle R. Drug-related problems: their structure and function. The Annals of Pharmacotherapy 1990; 24:1093-1097.
5. Alsalmi Z. Guide to Cardiology Pharmaceutical Care. Clinical Pharmacy section, Royal Hospital, Muscat, Oman. Feb; 2007.
6. Alsalmi Z. Impact of Infectious Disease Pharmacist on Patient Care. 7th *ESCMID* Summer School publication, Regensburg, *Germany*, July *2008*.
7. Ganguly SS, Al Shafee M, Al Maniri A. Modern lifestyle in Muscat 'brings new challenges'. College of Medicine and Health Sciences, Sultan Qaboos University, Muscat, Oman. http://www.gulfnews.com/News/Gulf/oman/10239784.html. Accessed on April 15, 2009.
8. Annual Health Report 2005, Sultanate of Oman, Ministry of health.
9. UNAIDS/WHO Working Group on Global HIV/AIDS and STI Surveillance, 2004 update. http://data.unaids.org/publications/Fact-Sheets01/oman_en.pdf. Accessed On April 15, 2009.
10. Alsalmi Z, McAnaw J, Lowrie R, Millar I, Hudson SA. Pharmaceutical care provided by a pharmacist supplementary prescriber in a primary care medication review clinic. Poster & Oral Communication. 7th *European Society of Clinical Pharmacy* Spring Conference, *Edinburgh*, UK, May *2007*.
11. Helper D, Strand L. Opportunities and responsibilities in pharmaceutical care. American Journal of Hospital pharmacy 1990; 47:533-543.
12. Krska J, John A, Cromarty, Fiona A, Debbie J, Denise H, et al. Pharmacist-led medication review in patients over 65: a randomized, controlled trial in primary care. Age and Ageing 2001; 30:205-211.
13. Elaine L, Lisa R. Drug-related problems in elderly general practice patients receiving pharmaceutical care. International Journal of pharmacy practice 2005; 13:165-178.
14. A Granas, I Bates. The effect of pharmaceutical review of repeat prescriptions in general practice. International Journal of pharmacy practice 1999; 7:264-275.
15. Hanlon J, Weinberger M, Samsa G, Schmader K, Uttech K, Lewis I, et al. A randomised, controlled trial of a clinical pharmacist intervention to improve inappropriate prescribing in elderly outpatients with polypharmacy. American Journal of Medecine 1996; 100:428-437.
16. Joh S, Janusz K, Connie S, Lisa D, Christel W, Andrew W, et al. A randomized controlled trial of a pharmacist consultation program for family physicians and their elderly patients. CMAJ 2003; 169.
17. Cassidy I, Keith M, Coffey E, Noyes A. Impact of pharmacist-operated general medicine chronic care refill clinics on practitioner time and quality of care. Ann Pharmacother 1996; 30:745-751.
18. Deady J, Lepinski P, Abramowitz P. Measuring the ability of clinical pharmacists to effect drug therapy changes in a family practice clinic using prognostic indicators. J Hosp Pharm 1991; 26:93-97.
19. Lobas N, Lepinski P, Abramowitz P. Effects of pharmaceutical care on medication costs and quality of patient care in an ambulatory-care clinic. Am J Hosp Pharm 1992; 49: 681-1688.