The Potential Role of Clinical Pharmacy Services in Patients with Cardiovascular Diseases

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Abstract

Clinical pharmacy is deemed an integral component of a health care system. The presence of clinical pharmacists in medical rounds could assist physicians in optimizing patients' pharmacotherapy. Moreover, clinical pharmacists may reduce adverse effects and medication errors insofar as they contribute significantly to the detection and management of drug-related problems, not least in patients with cardiovascular diseases, who have the highest rank in the frequency of medication errors. Clinical pharmacists can also collaborate with physicians in the management of cardiovascular risk factors as well as anticoagulation therapy based on patients’ specific situations.

In summary, the practice of clinical pharmacy is considered a crucial part of a health care team to improve the level of patients' care by increasing the quality of therapy with the least expense for a health care system.

Keywords: Pharmacy • Cardiovascular diseases • Professional role • Patient care team

Introduction

The practice of clinical pharmacy is regarded as an imperative part of a health care team to provide the best quality use of medicines. This goal can be achieved by participation in the management of individual patients, incorporation of the best available evidence, and transfer of this knowledge to health care professionals in all practice settings to guarantee the utmost possible quality of patient care.

The main objective of this review is to summarize the role of clinical pharmacy services in all facets of cardiovascular diseases (CVD) in hospitalized patients.

For the purposes of the present review, databases including MEDLINE/PUBMED and Scopus as well as trial registries were systematically searched from inception through March 2nd, 2012. Keywords were: clinical pharmacy/pharmacist and cardiology, cardiovascular, cardiac, heart failure, hypertension, diabetes, dyslipidemia, and anticoagulant. Attempts were made to include all studies reporting the impact of clinical pharmacy services with a focus on an inpatient setting. European studies that involved hospital pharmacists were also included since the number of clinical pharmacists was limited in these countries. The primary outcome measure assessed was the difference between the levels of care in patients receiving pharmaceutical services versus those receiving standard treatment. The results of this search were classified into prevention of drug-related
problems, management of cardiovascular risk factors, pharmaceutical care provided for heart failure patients, and anticoagulant management service.

**Prevention and Reduction of Episodes of Drug-Related Problems**

A known drawback of medications is the untoward events that can occur in the wake of their use.2-6 These detrimental effects can happen as a result of the inevitable pharmacological properties of medicines or their improper use, which is referred to as medication errors. Medication errors mostly occur in the prescribing process7 but they are not unavoidable: the fewer medication errors, the less morbidity, mortality, hospital stay, and cost.8-10 The presence of clinical pharmacists in rounds in tandem with other health care professionals is an effective strategy for reducing the number of preventable adverse events.11-14 On account of the fact that cardiovascular medications are the class with the most severe untoward events,15 it is even more important to have clinical pharmacists participate in cardiology wards.

The predominance of errors in cardiovascular medications can be attributed to the fact that the number and complexity of options in this therapeutic class continue to rise.1 Cooperation between clinical pharmacists and physicians at the time of ordering can both prevent adverse events and help in identifying errors.32 Clinical pharmacists can help physicians upon prescribing by providing them with detailed information on the pharmacokinetic and pharmacodynamic characteristics of medications such as dosing, interactions, indications, and alternatives based on the patient’s situation.12

To sum up, clinical pharmacists’ contribution in cardiac unit rounds or visits is considered to be one of the major fields in which their presence has been proved to be very helpful.

**Management of Cardiovascular Risk Factors**

Clinical pharmacists play an essential role in the management of patients with chronic diseases. Their mission in optimizing treatment outcomes by increasing the rate of achieving therapeutic goals and decreasing the cost of therapy for both patients and health care settings is believed to be crucial.16-21

**Hyperglycemia**

Hyperglycemia is associated with poor clinical outcomes in patients with any kind of concomitant diseases.22 Increased mortality is observed in hyperglycemic patients hospitalized in an intensive care unit.23 Complications of cardiac surgery, including wound infections, is more frequently seen in patients with hyperglycemia.24,25 Acute or stress-induced hyperglycemia rather than chronic diabetes is a better predictor of surgery-associated complications and mortality.26,27 Irrespective of the reason behind high blood glucose level, hyperglycemic patients with CVD, including those with acute myocardial infarction, arrhythmia, unstable angina, and pulmonary embolism, tend to show increased mortality. The fact that half of patients in cardiac care units may have diabetes26,29 adds to the significance of blood glucose level control in those with CVD. Furthermore, some of the medications used in the pharmacotherapy of CVD may induce new onset diabetes.30 Diuretics, beta blockers, and calcium channel blockers are believed to increase the risk of new onset diabetes.31-37

Clinical pharmacists’ role is even further highlighted in the elaboration and implementation of the protocols for glycemic control, calculation of required insulin dose, monitoring of patients’ blood glucose level, and reconciliation of discharge medication.38 The active presence of clinical pharmacists in the insulin regimen management of hospitalized patients was reported to have reduced length of hospital stay, rate of hyperglycemia, and also hypoglycemic events.39 Moreover, the inappropriate use of sliding scale insulin regimen without using basal insulin reduced significantly (p value < 0.0001).39

Clinical pharmacists should, therefore, be present as a team member in the management of hyperglycemia in an inpatient setting in order to furnish the necessary information regarding blood glucose monitoring with a view to bettering patients’ clinical outcome. It is deserving of note that fear of hypoglycemia is one of the barriers to adequate blood glucose control; clinical pharmacists’ input could help in overcoming this problem.38

**Hypertension**

Proper management of hypertension is of great importance in patients with CVD. Controlling blood pressure can decrease the incidence of myocardial infarction (20-25%) and heart failure (more than 50%).40 The British Heart Foundation Statistics Database estimated that only 40% of treated hypertensive patients were controlled.41 The number was the same for the United States, where 37% of hypertensive patients were at their blood pressure goal.42 Although it seems that limited access to care might be a common reason for poor blood pressure control,40 Hyman and Pavlik reported that most cases of uncontrolled hypertension occurred in elderly patients who had frequent physician visits.43 Regular physician visits did not lead to improved control of blood pressure in other studies, as well.44,45

The presence of pharmacists to monitor hypertensive patients’ use of medications, provide information about potential adverse effects, and avoid drug interactions is encouraged by the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood
The Potential Role of Clinical Pharmacy Services in Patients with Cardiovascular Diseases

Pressure. Several studies have demonstrated that the incorporation of clinical pharmacists in the management of hypertensive patients yields promising outcomes. This involvement could have a superior consequence if made in the hospital setting rather than the community (49-53% vs. 96-98%). The discrepancy may be explained by the fact that in community pharmacies, close communication between pharmacists and physicians may not be feasible. A meaningfully positive impact on physicians’ prescription of medicines requires face-to-face academic visits between pharmacists and physicians in the practice setting. In a randomized, controlled trial on 95 hypertensive patients having been randomly distributed between a control arm of standard medical care and an intervention arm in which a physician and pharmacist collaborated with each other as a team, the systolic and diastolic blood pressures declined significantly in the intervention arm as compared to those in the control arm (23 vs. 11 mmHg and 14 vs. 3 mmHg), which led to a higher achievement rate of blood pressure goal in the intervention arm. In conclusion, the attendance of clinical pharmacists as an integral member of a health care team could enhance the rate of blood pressure control and lessen drug interactions and costs for both patients and health care systems.

The involvement of clinical pharmacists in the treatment decision-making process at the time of the prescription of medications is advantageous to the management of patients, especially those with chronic diseases. In several hospital settings, physicians’ responsibility is to diagnose the disease; whereas in situations where pharmacotherapy is required, clinical pharmacists should select the best choice and monitor patients for clinical response.

Hypertension

A systematic review of 21 randomized clinical trials, conducted on studies that evaluated the impact of clinical pharmacy services on the screening and treatment of patients with dyslipidemia, revealed that collaborative care involving clinical pharmacists had led to improved outcomes in patients with dyslipidemia. This improved level of care was manifested by better control of total cholesterol, low-density lipoprotein (LDL), and triglyceride. Such success can be explained by the fact that clinical pharmacists play a significant role in making effective drug-therapy selection as well as educating patients regarding dyslipidemia and prescribed medications; this can enhance control and adherence in the long term.

In a prospective study, conducted by Bozovich et al., the proportion of patients at their LDL goal at 6 months’ follow-up was higher in those enrolled in clinical pharmacist-managed lipid disorders clinic than in the ones having received standard care provided by cardiologists (69% vs. 50%, p value = 0.016). Geber et al. evaluated the level of care provided by clinical pharmacists as opposed to that furnished via standard care by physicians in patients with high baseline LDL and reported a significantly high number of patients who attained their LDL goal among those receiving pharmacotherapy care compared to the ones receiving standard care (p value < 0.001).

In brief, collaboration between clinical pharmacists and physicians for the management of patients with dyslipidemia can increase the number of individuals who succeed in achieving their target lipid levels. Therefore, the establishment of such clinical pharmacy clinics should be supported particularly in communities where patients are generally unaware of the role of clinical pharmacists.

Management of Patients with Heart Failure

Patients with heart failure experience frequent hospital admissions due to the progressive and chronic nature of their disease. These frequent hospital admissions may beget changes in patients’ drug regimens. Prescription errors or alterations to patients’ medications without the provision of sufficient education can result in readmissions.

Pharmacotherapy management is the main treatment in patients with heart failure; optimizing the pharmacological therapy and encouraging patients’ adherence are essential for improving disease management and reducing the rate of hospitalization.

Pharmaceutical care provided by clinical pharmacists as members of a multidisciplinary team responsible for patients with heart failure can decrease the risk of hospitalization. Not only can pharmacists’ interventions improve patients’ adherence but also they can offer them economic assistance by reducing health care-associated costs. Such targets can be achieved by counseling clinical pharmacists before patient discharge.

Clinical pharmacists can avoid prescription errors and provide patients with education regarding the medications ordered. Moreover, in the care of patients with heart failure after the implantation of left ventricular assist devices, clinical pharmacists are known to have improved drug-therapy issues significantly. These services rendered by clinical pharmacists can bring about a decrease in patients’ readmissions and an increase in their quality of life.

One of the other approaches that clinical pharmacists can apply to help patients with heart failure is to reduce the rate of discrepancies between prescribed medications in each of admissions and those used previously by reviewing patients’ preadmission medication lists. This can be achieved by taking a past medical history of patients upon admission and providing physicians with this information at the time of ordering.

In a nutshell, because heart failure is associated with high
rates of hospital admissions and clinical pharmacists’ interventions can reduce this rate by one third, the presence of clinical pharmacists in the heart failure team is highly recommended.

**Anticoagulants Clinic**

A clinical pharmacist-managed anticoagulation service is believed to boost the control of patients with respect to therapeutic goals and reduce the rate of adverse effects of anticoagulants as well as the occurrence of thromboembolic events as was attested to by studies that involved trained clinical pharmacists in the management of patients on anticoagulants due to a wide variety of indications and durations using a specialized approach. In the Witt et al. study, the level of care provided by clinical pharmacists was compared to that furnished by experienced physicians: patients in the former group showed a statistically significant decrease in anticoagulation therapy and thromboembolic complications. This improved outcome in those enrolled in the pharmacotherapy clinic is due to the greater percentage of time that the patients spent on their therapeutic goals.

Clinical pharmacists devise protocols for every single anticoagulant utilized in a hospital setting and define parameters with which they can initiate, monitor, and adjust anticoagulation therapy in every written protocol. Drawing upon these protocols, clinical pharmacists review and manage each patient’s therapy and also evaluate the response to ongoing medications. Consequently, the superior outcome of anticoagulation management along with a reduction in costs supports the recommendation for a widespread implementation of clinical pharmacists’ anticoagulation management.

**Other Activities**

Clinical pharmacy services are not limited to the above-mentioned activities. Among the ever-expanding roles that clinical pharmacists implement in the health care system, therapeutic drug monitoring and managing of patients’ pharmacotherapy are of great importance as much as they can significantly improve patient care. Any changes in patients’ situations can create alterations to the pharmacokinetic and pharmacodynamic of medications. The presence of clinical pharmacists can be helpful in such circumstances, for these changes normally necessitate modification in drug dosing.

Perioperative and postoperative management of patients undergoing cardiac surgery is another area where clinical pharmacists can come to the aid of physicians, not least in determining the optimal time for the cessation and re-initiation of the medications that patients receive before surgery and thus reducing drug-related complications.

**Conclusion**

Cumulative evidence in the existing literature supports the benefits of the presence of clinical pharmacists in a hospital setting, and in particular, in cardiology wards. Clinical pharmacists’ participation in medical rounds can be helpful in the prevention of medication errors and their expertise in pharmacotherapy can assist in managing drug therapy based on patient-specific factors. Improvements in patients’ safety, level of care, and anticoagulant management in addition to better control of cardiovascular risk factors and reduction in health care costs justify the need for active collaboration between clinical pharmacists and physicians in the management of patients with cardiovascular diseases.

**References**

1. George PP, Molina JA, Cheah J, Chan SC, Lim BP. The evolving role of the community pharmacist in chronic disease management - a literature review. Ann Acad Med Singapore 2010;39:861-867.
2. Kanjanarat P, Winterstein AG, Johns TE, Hatton RC, Gonzalez-Rothi R, Segal R. Nature of preventable adverse drug events in hospitals: a literature review. Am J Health Syst Pharm 2003;60:1750-1759.
3. Bates DW, Leape LL, Petrycki S. Incidence and preventability of adverse drug events in hospitalized adults. J Gen Intern Med 1993;8:289-294.
4. Cano FG, Rozenfeld S. Adverse drug events in hospitals: a systematic review. Cad Saude Publica 2009;25:S360-S372.
5. Thomsen LA, Winterstein AG, Sondergaard B, Haugbolle LS, Melander A. Systematic review of the incidence and characteristics of preventable adverse drug events in ambulatory care. Ann Pharmacother 2007;41:1411-1426.
6. Kaushal R, Bates DW, Landrigan C, McKenna KJ, Clapp MD, Federico F, Goldmann DA. Medication errors and adverse drug events in pediatric inpatients. JAMA 2001;285:2114-2120.
7. Bates DW, Cullen DJ, Laird N, Petersen LA, Small MD, Servi D, Laffel G, Sweitzer BJ, Shea BF, Hallissey R. Incidence of adverse drug events and potential adverse drug events implications for prevention. JAMA 1995;274:29-34.
8. Kelly WN. Potential risks and prevention. Part 1: Fatal adverse drug events. Am J Health Syst Pharm 2001;58:1317-1324.
9. Phillips J, Bean S, Brinker A, Holquist C, Honig P, Lee LY, Pamer C. Retrospective analysis of mortalities associated with medication errors. Am J Health Syst Pharm 2001;58:1835-1841.
10. Rothschild JM. Analysis of Medication-related malpractice claims: causes, preventability, and costs. Arch Intern Med 2002;162:2414-2420.
11. Kucukarslan SN, Peters M, Mlynarek M, Nafziger DA. Pharmacists on rounding teams reduce preventable adverse drug events in
hospital general medicine units. Arch Intern Med 2003;163:2014-2018.
12. Leape LL, Cullen DJ, Clapp MD, Burdick E, Demonaco HJ, Erickson JL, Bates DW. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. JAMA 1999;282:267-270.
13. Sangherna N, Chan PY, Khaki ZF, Plummer C, Lee KK, Crauswick NE, Wong IC. Interventions of hospital pharmacists in improving drug therapy in children: a systematic literature review. Drug Saf 2006;29:1031-1047.
14. Kaboli PJ, Hoth AB, McClimon BJ, Schnipper JL. Clinical pharmacists and inpatient medical care: a systematic review. Arch Intern Med 2006;166:955-964.
15. LaPointe NM, Jullis JG. Medication errors in hospitalized cardiovascular patients. Arch Intern Med 2003;163:1461-1466.
16. Ramser KL, Sprabrey LR, George CM, Hamann GL, Vallejo VA, Dorko CS, Kuhl DA. Physician-pharmacist collaboration in the management of patients with diabetes resistant to usual care. Diabetes Spectrum 2008;21:209-214.
17. Cording MA, Engelbrecht-Zadvrony EB, Petit BJ, Eastham JH, Sandoval R. Development of a pharmacist-managed lipid clinic. Ann Pharmacother 2002;36:892-904.
18. Carter DL, Arder G, Dawson JD, James PA, Bergus GR, Doucette WR, Chrischilles EA, Francisius CL, Xu Y. Physician and pharmacist collaboration to improve blood pressure control. Arch Intern Med 2009;169:1996-2002.
19. Murray MD, Ritchie ME, Wu J, Tu W. Effect of a pharmacist on adverse drug events and medication errors in outpatients with cardiovascular disease. Arch Intern Med 2009;169:757-763.
20. Kelly CJG, Booth G. Pharmacist-led structured care for patients with diabetic nephropathy, Br J Diabetes Vasc Dis 2008;8:86-88.
21. McLean DL, McAlistier FA, Johnson JA, King KM, Makowski MJ, Jones CA, Tsuyuki RT. SCRIP-HTN Investigators. A randomized trial of the effect of community pharmacist and nurse care on improving blood pressure management in patients with diabetes mellitus: study of cardiovascular risk intervention by pharmacists-hypertension (SCRIP-HTN). Arch Intern Med 2008;168:2355-2361.
22. Moghissi ES. Reexamining the evidence for inpatient glucose control: new recommendations for glycemic targets. Am J Health Syst Pharm 2010;67:S3-8.
23. Kinsley JS. Association between hyperglycemia and increased hospital mortality in a heterogeneous population of critically ill patients. Mayo Clin Proc 2003;78:1471-1478.
24. Fumary AP, Zerr KJ, Gunkemeier GL, Starr A. Continuous intravenous insulin infusion reduces the incidence of deep sternal wound infection in diabetic patients after cardiac surgical procedures. Ann Thorac Surg 1999;67:352-360.
25. Fumary AP, Gao G, Gunkeneier GL, Wu Y, Zerr KJ, Bookin SO, Floten HS, Starr A. Continuous insulin infusion reduces mortality in patients with diabetes undergoing coronary artery bypass grafting. J Thorac Cardiovasc Surg 2003;125:1007-1021.
26. Capes SE, Hunt D, Malmberg K, Gerstein HC. Stress hyperglycaemia and increased risk of death after myocardial infarction in patients with and without diabetes: a systematic overview. Lancet 2000;355:773-778.
27. Marik PE, Raghuban M. Stress hyperglycemia, insulin and immunomodulation in sepsis. Intensive Care Med 2004;30:748-756.
28. Green Conaway DL, Enriquez JR, Barberena JE, Jones PG, O’Keefe JH, Jr, Speratus JA. Assessment of and physician response to glycemic control in diabetic patients presenting with an acute coronary syndrome. Am Heart J 2006;152:1022-1027.
29. Norhammar A, Tenerz A, Nilsson G, Hamsten A, Efendic S, Ryden L, Malmberg K. Glucose metabolism in patients with acute myocardial infarction and no previous diagnosis of diabetes mellitus: a prospective study. Lancet 2002;359:2140-2144.
30. Jong GP, Chang MH, Tien L, Li SY, Liu YS, Lung CH, Ma T. Antihypertensive drugs and new-onset diabetes: a retrospective longitudinal cohort study. Cardiovasc Ther 2009;27:159-163.
31. Elliott WJ. Differential effects of antihypertensive drugs on new-onset diabetes? Curr Hypertens Rep 2005;7:249-256.
32. Padwal R, Laupacis A. Antihypertensive therapy and incidence of type 2 diabetes: a systematic review. Diabetes Care 2004;27:247-255.
33. Mancia G, Grassi G, Zanchetti A. New-onset diabetes and antihypertensive drugs. J Hypertens 2006;24:3-10.
34. Verdecchia P, Angeli F, Reboli G, Battaglioni R. Is the development of diabetes with antihypertensive therapy a problem?--Pro. J Clin Hypertens (Greenwich) 2006;8:120-126.
35. Taylor EN, Hu FB, Curhan GC. Antihypertensive medications and the risk of incident type 2 diabetes. Diabetes Care 2006;29:1065-1070.
36. Sarafidis PA, Bakris GL. Antihypertensive therapy and the risk of new-onset diabetes. Diabetes Care 2006;29:1167-1169.
37. Verdecchia P, Angeli F, Reboli G, Battaglioni R. New-onset diabetes in treated hypertensive patients. Curr Hypertens Rep 2005;7:174-179.
38. Kirk JK, Oldham EC. Hyperglycemia management using insulin in the acute care setting: therapies and strategies for care in the non-critically ill patient. Ann Pharmacother 2010;44:1222-1230.
39. Eppley M, Sarg S. Hyperglycemia management in the hospital: the pharmacist’s role. Hosp Pharm 2009;44:594-603.
40. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, Jr. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. Hypertension 2003;42:1206-1252.
41. Blood pressure. Chapter 9, BHF Coronary heart disease statistics. Published May 2006. http://www.heartstats.org/ temp/Chaptersp9.pdf. (20 October 2011)
42. Ong KL, Chung BM, Man YB, Lau CP, Lam KS. Prevalence, awareness, treatment, and control of hypertension among United States adults 1999-2004. Hypertension 2007;49:69-75.
43. Hyman DJ, Pavlik VN. Characteristics of patients with uncontrolled hypertension in the United States. N Engl J Med 2001;345:479-486.
44. Berlowitz DR, Ash AS, Hickey EC, Friedman RH, Glickman M, Kader B, Moskowitz MA. Inadequate management of blood pressure in a hypertensive population. N Engl J Med 1998;339:1957-1963.
45. Oliveira SA, Lapuerta P, McCarthy BD, Ll’Italijan Gl, Berlowitz DR, Asch SM. Physician-related barriers to the effective management of uncontrolled hypertension. Arch Intern Med 2002;162:413-420.
46. No authors listed. The sixth report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure. Arch Intern Med 1997;157:2413-2446.
47. Carter BL, Zillich AJ, Elliott WJ. How pharmacists can assist physicians with controlling blood pressure. J Clin Hypertens 2003;5:31-37.
48. Neto PR, Marusic S, de Lyra Júnior DP, Pilger D, Cruciol-Souza JM, Gaeti WP, Cuman RK. Effect of a 36-month pharmaceutical care program on the coronary heart disease risk in elderly diabetic and hypertensive patients. J Pharm Pharm Sci 2011;14:249-263.
49. Borenstein JE, Graber G, Saltiel E, Wallace J, Ryu S, Archi J, Deutsch S, Weingarten SR. Physician–pharmacist co-management of hypertension: a randomized, comparative trial. Pharmacotherapy 2003;23:209-216.
50. Vivian EM. Improving blood pressure control in a pharmacist-managed hypertension clinic. Pharmacotherapy 2002;22:1533-1540.
51. Walsh JM, McDonald KM, Shojaiania KG, Sundaram V, Nayak S, Lewis R, Owens DK, Goldstein MK. Quality improvement strategies for hypertension management: a systematic review. Med Care 2006;44:646-657.
52. Chrischilles EA, Carter BL, Lund BC, Rubenstein LM, Chen-Hardee SS, Voelker MD, Park TR, Kuehl AK. Evaluation of the Iowa Medicaid pharmaceutical care management program. J Am Pharm Assoc (Wash DC) 2004;44:337-349.
The Journal of Tehran University Heart Center

53. Park JJ, Kelly P, Carter BL, Burgess PP. Comprehensive pharmaceutical care in the chain (pharmacy) setting. J Am Pharm Assoc (Wash) 1996;NS36:443-451.
54. Carter BL, Hellings DK. Ambulatory care pharmacy services: has the agenda changed? Ann Pharmacother 2000;34:772-787.
55. Charrois TL, Zolezzi M, Koshman SL, Pearson G, Makowsky M, Durec T, Tsuyuki RT. A systematic review of the evidence for pharmacist care of patients with dyslipidemia. Pharmacotherapy 2012;32:222-233.
56. Machado M, Nassor N, Bajcar JM, Guzzo GC, Einhorn TR. Sensitivity of patient outcomes to pharmacist interventions. Part III: systematic review and meta-analysis in hyperlipidemia management. Ann Pharmacother 2008;42:1195-1207.
57. Gerrald KR, Dixon DL, Barnette DJ, Williams VG. Evaluation of a pharmacist-managed lipid clinic that uses point-of-care lipid testing. J Clin Lipidol 2010;4:120-125.
58. Bozovich M, Rubino CM, Edmunds J. Effect of a clinical pharmacist-managed lipid clinic on achieving National Cholesterol Education Program low-density lipoprotein goals. Pharmacotherapy 2000;20:1375-1383.
59. Geber J, Parra D, Beckey NP, Korman L. Optimizing drug therapy in patients with cardiovascular disease: the impact of pharmacist-managed pharmacotherapy clinics in a primary care setting. Pharmacotherapy 2002;22:738-747.
60. Jaarsma T, Haaijer-Ruskamp FM, Sturm H, Van Veldhuisen DJ. Management of heart failure in The Netherlands. Eur J Heart Fail 2005;7:371-375.
61. Michalsen A, Koning G, Thimme W. Preventable causative factors leading to hospital admission with decompensated heart failure. Heart 1998;80:437-441.
62. Coleman EA, Smith JD, Raha D, Min SJ. Posthospital medication discrepancies, prevalence’s and contributing factors. Arch Intern Med 2005;165:1842-1847.
63. Eggink RN, Lenderink AW, Widdershoven JW, van den Bent PM. The effect of a clinical pharmacist discharge service on medication discrepancies in patients with heart failure. Pharm World Sci 2010;32:759-766.
64. Koshman SH, Charrois TL, Simpson SH, McAlister FA, Tsuyuki RT. Pharmacist care of patients with heart failure, a systematic review of randomized trials. Arch Intern Med 2008;168:687-694.
65. Yu DSF, Thompson DR, Lee DTF. Disease management programmes for older people with heart failure: crucial characteristics which improve post-discharge outcomes. Eur J Heart Fail 2006;27:596-612.
66. Murray MD, Young J, Hoke S, Tu W, Weiner M, Morrow D, Stroupe KT, Wu J, Clark D, Smith F, Gradus-Pizlo I, Weinberger M, Brater DC. Pharmacist intervention to improve medication adherence in heart failure, a randomized trial. Ann Intern Med 2007;146:714-725.
67. Al-Rashed SA, Wright DJ, Roebuck N, Sunter W, Chrystyn H. The value of inpatient pharmaceutical counselling to elderly patients prior to discharge. Br J Clin Pharmacol 2002;54:657-664.
68. Jennings DL, Brewer R, Smith C, Williams C. Clinical pharmacist intervention for patients with left ventricular assist devices. Ann Pharmacother 2011;45:1311-1312.
69. Phillips CO, Wright SM, Kern DE, Singa RM, Shepperd S, Rubin HR. Comprehensive discharge planning with post discharge support for older patients with congestive heart failure, a meta-analysis. JAMA 2004;291:1358-1367.
70. Rainville EC. Impact of pharmacist interventions on hospital readmissions for heart failure. Am J Health Syst Pharm 1999;56:1339-1342.
71. Stewart S, Pearson S, Horowitz JD. Effects of a home-based intervention among patients with congestive heart failure discharged from acute hospital care. Arch Intern Med 1998;158:1067-1072.
72. Bolas H, Brookes K, Scott M, McElray J. Evaluation of a hospital-based community liaison pharmacy service in northern Ireland. Pharm World Sci 2004;26:114-120.
73. Witt DM, Sadler MA, Shanahan RL, Mazzoli G, Tillman DJ. Effect of a centralized clinical pharmacy anticoagulation service on the outcomes of anticoagulation therapy. Chest 2005;127:1515-1522.
74. Garabedian-Ruffalo SM, Gray DR, Sax MJ, Ruffalo RL. Retrospective evaluation of a pharmacist-managed warfarin anticoagulation clinic. Am J Hosp Pharm 1985;42:304-308.
75. Witt VM, Guns JG, Ahmed OI, Moore LM. Outcome analysis of a pharmacist-managed anticoagulation service. Pharmacotherapy 1995;15:732-739.
76. Chiquette E, Amato MG, Bushey H. Comparison of an anticoagulation clinic with usual medical care: anticoagulation control, patient outcomes, and health care costs. Arch Intern Med 1998;158:1641-1647.
77. Cortelazzo S, Finazzi G, Viero P, Galli M, Remuzzi A, Parenzani L, Barbui T. Thrombotic and hemorrhagic complications in patients with mechanical heart valve prosthesis attending an anticoagulation clinic. Thromb Haemost 1993;69:316-320.
78. Tsuyuki RT, McKelvie RS, Arnold JM, Avezum A, Jr, Barretto AC, Carvalho AC, Isaac DL, Kitching AD, Piegas LS, Teo KK, Yusuf S. Acute precipitants of congestive heart failure exacerbations. Arch Intern Med 2001;161:2337-2342.
79. Schilig J, Kaatz S, Hudson M, Krol GD, Szandzik EG, Kalus JS. Clinical and safety impact of an inpatient pharmacist-directed anticoagulation service. J Hosp Med 2011;6:322-328.