http://www.kidney-international.org

Comparison of primary health-care models in the management of chronic kidney disease

Alfonso M. Cueto-Manzano[1], Héctor R. Martínez-Ramírez[1] and Laura Cortés-Sanabria[1]

[1]*Unidad de Investigación Médica en Enfermedades Renales, Hospital de Especialidades, Jalisco, Mexico*

Negative lifestyle habits (potential risks for chronic kidney disease, CKD) are rarely modified by physicians in a conventional health-care model (CHCM). Multidisciplinary strategies may have better results; however, there is no information on their application in the early stages of CKD. Thus, the aim of this study was to compare a multiple intervention model versus CHCM on lifestyle and renal function in patients with type 2 diabetes mellitus and CKD stage 1–2. In a prospective cohort study, a family medicine unit (FMU) was assigned a multiple intervention model (MIM) and another continued with conventional health-care model (CHCM). MIM patients received an educational intervention guided by a multidisciplinary team (family physician (FP), social worker, dietitian, physical trainer); self-help groups functioned with free activities throughout the study. CHCM patients were managed only by the FP, who decided if patients needed referral to other professionals. Thirty-nine patients were studied in each cohort. According to a lifestyle questionnaire, no baseline differences were found between cohorts, but results reflected an unhealthy lifestyle. After 6 months of follow-up, both cohorts showed significant improvement in their dietary habits. Compared to CHCM diet, exercise, emotional management, knowledge of disease, and adherence to treatment showed greater improvement in the MIM. Blood pressure decreased in both cohorts, but body mass index, waist circumference, and HbA_{1C} significantly decreased only in MIM. Glomerular filtration rate (GFR) was maintained equally in both cohorts, but albuminuria significantly decreased only in MIM. In conclusion, MIM achieves better control of lifestyle-related variables and CKD risk factors in type 2 diabetes mellitus (DM2) patients with CKD stage 1–2. Broadly, implementation of a MIM in primary health care may produce superior results that might assist in preventing the progression of CKD.

Kidney International Supplements (2013) **3,** 210–214; doi:10.1038/kisup.2013.16

KEYWORDS: CKD; conventional health-care model; multidisciplinary intervention model; primary health care

Correspondence: *Alfonso M. Cueto-Manzano, Unidad de Investigación Médica en Enfermedades Renales, Hospital de Especialidades, CMNO, IMSS, Belisario Domínguez No 1000, Col. Independencia, Guadalajara, Jalisco, Mexico. E-mail: a_cueto_manzano@hotmail.com*

INTRODUCTION

Chronic kidney disease (CKD) is a worldwide epidemic[1] and represents one of the most important challenges for health systems, particularly in developing countries.[2] CKD is associated with premature cardiovascular disease and mortality.[3,4] Unfortunately, many patients with CKD in the early stages are not opportunely diagnosed in the primary health-care setting.[5] Moreover, frequently, primary physicians do not have sufficient clinical knowledge to manage nephropathy.[6] Subsequently, only a small proportion of patients receive adequate treatment and achieve clinical practice recommendations for CKD.[7]

We have previously shown that instruction of FPs on the subject of educational interventions increased their clinical competence and was associated with the preservation of renal function in patients with DM2 and early CKD (stages 1 and 2).[6] Notwithstanding, risk factors related to lifestyle, such as smoking, overweight-obesity, hyperglycemia, and hyperlipidemia, have not been significantly modified either by the nephrologist[8] or the FP receiving these interventions.[6] A multiple educational strategy directed at patients at high risk of developing CKD, guided by multidisciplinary teams (social worker, dietitian, physical trainer, and FP) and supported by self-care groups, significantly improved their lifestyle and dietary habits.[9]

Therefore, this study was designed to test the hypothesis that, besides adequate training for FPs, a multiple educative approach directed at patients and guided by a multidisciplinary health-care team would attain better results on lifestyle habits and renal function of DM2 patients with early CKD than a conventional approach in which the primary physician plays the major role in treating patients, and decides when to refer them to other health professionals.

PATIENTS AND METHODS

In a prospective cohort study, DM2 patients of two FMUs of the Mexican Institute of Social Security (IMSS), Greater Guadalajara area, were included. One unit (FMU No. 34) was assigned to evaluate a MIM as it had implemented the model for several years (although this model is not employed in the whole patient population). Another unit (FMU No. 78) was randomly selected as a control cohort from among 20 units using a CHCM. Patients without a previous diagnosis of CKD were identified in a screening program; those with early

CKD were invited to participate and included after informed written consent. Early CKD was defined as the presence of microalbuminuria with normal or slightly decreased GFR ($\geqslant$60 ml/min per 1.73 m^2). GFR was calculated by using the four-variable isotope-dilution mass spectrometry-traceable Modification of Diet in Renal Disease Study equation.[10] At screening, microalbuminuria was evaluated with dipsticks (Micral-test II; Roche Diagnostics GmbH, Mannheim, Germany) in a first-void urine sample. Positive results were confirmed by immunoturbidimetry (Vitros 5600 Integrated System; Ortho Clinical Diagnostics, Rochester, MN) and adjusted to creatinuria; this latter methodology was also used at 3- and 6-month evaluations.

No patient in the MIM had a previous exposure to this model. After accepting to participate, all of them received an educational intervention (2 h/week over 4 weeks) comprising information sessions guided by a multidisciplinary team: emotional management skills (conducted by a social worker), nutritional advice (by a dietitian), exercise (by a physical trainer), and health-related problems (by a FP). During the initial month, patients elected a leader from among themselves, who coordinated, detected needs, and promoted free activities (social, exercise, or health-related) for the group, supported by the professional team, for the duration of the study. Appointments were made every 3 months to evaluate the status of individuals and groups, perform group dynamics, establish goals for the next meeting, and identify patients requiring individual support. On the other hand, patients in CHCM were managed only by the FP, who provided assessments and treatments to patients as they saw fit, and decided if a subject needed to be referred to other health professionals. All patients completed a lifestyle questionnaire at baseline and at the end of follow-up (6 months), and had clinical and biochemical evaluations performed every 3 months. The lifestyle questionnaire (IMEVID)[11] is a self-response instrument, evaluating seven domains: diet, exercise, consumption of tobacco and alcohol, emotional management, knowledge of disease, and adherence to treatment. The scale runs from 0 to 100; the higher the score, the healthier the behavior. Concurrently, all patients made regular monthly visits to the FP.

Additionally, all the FPs themselves received an educational intervention regarding DM2 and CKD by means of an interactive theory–practice model based on the content of the *Clinical Practice Guidelines for Prevention, Diagnosis and Treatment of Early CKD* (available on the website of the National Center for Health Technology Excellence, Mexican Ministry of Health).[12] The educational strategy included theory as well as discussion of real clinical cases every week up to a total of 40 h within the first 3 months of the study. After finishing the educational intervention, no additional training was undertaken. To measure clinical competence, a previously validated questionnaire on diabetic nephropathy[13] was completed by all physicians at baseline and after the conclusion of the course.

Statistical analysis

Data are expressed as mean $\pm$ s.d. or median (25–75% percentiles) when dimensional variables had parametric or nonparametric distribution, respectively, or as percentage in the case of nominal variables. Comparisons between groups were performed using independent Student *t*, Mann–Whitney *U*, or χ^2 tests, as appropriate. Intragroup analysis was performed using paired-samples Student *t*, Wilcoxon, or McNemar tests, as appropriate. A P value <0.05 was accepted as significant, but the exact value is preferentially shown.

RESULTS

Sociodemographic and lifestyle results

Ninety-six out of 300 evaluated patients had confirmed early CKD: 45 in MIM and 51 in CHCM. Currently, 39 patients have completed 6 months of follow-up in each cohort (results of these latter patients will be shown).

Baseline sociodemographic characteristics were similar between cohorts (Table 1). Results of the lifestyle questionnaire are shown in Table 2; at baseline, there were no significant differences between the cohorts; however, results reflected an unhealthy lifestyle. After 6 months, the total score and dietary habits displayed improvement in both cohorts; however, these and other variables evaluated by the instrument (knowledge of disease, adherence to treatment, emotional management, exercise, and tobacco and alcohol consumption) showed more improvement in MIM than in CHCM.

Clinical and biochemical results

Table 3 shows the results of the clinical and biochemical variables. Concomitantly with changes in lifestyle, blood pressure decreased in patients of both cohorts. Body mass index, waist circumference, and HbA_{1C} significantly decreased in patients in MIM, whereas they were unchanged in CHCM.

Renal function results

After a 6-month follow-up, GFR was maintained at similar levels in patients of both cohorts; however, albuminuria, despite having tended to be higher at baseline, significantly

Table 1 | Comparison of baseline demographic variables between patients of both cohorts

Variable	MIM (*N* 45)	CHCM (*N* 51)	*P*
Age (years)	62 $\pm$ 11	61 $\pm$ 10	0.64
Male gender, *N* (%)	24 (53)	29 (57)	0.73
Illiteracy, *N* (%)	8 (17)	4 (8)	0.88
Smoking, *N* (%)	9 (20)	9 (18)	0.43
Alcoholism, *N* (%)	6 (13)	8 (16)	0.89
Duration of diabetes (years)	13 (7–15)	14 (7–18)	0.67
Hypertension, *N* (%)	31 (69)	38 (74)	0.54
Duration of hypertension (years)	7 (3–13)	8 (3–14)	0.89
Family history of, N (%)			
Diabetes	31 (69)	43 (84)	0.10
Hypertension	11 (24)	13 (25)	0.95
CKD	7 (15)	9 (18)	0.78

Abbreviations: CHCM, conventional health-care model; MIM, multiple intervention model.

Table 2 | Comparison of lifestyle patterns between patients of both cohorts

Variable	MIM (*N*=39)		CHCM (*N*=39)		Possible highest score
	Baseline	Final	Baseline	Final	
Knowledge of disease	2.8 ± 2.9	5.4 ± 2.7*,†	3.6 ± 2.4	4.5 ± 2.5	8
Adherence to treatment	11.3 ± 4.5	13.8 ± 3.0	12.2 ± 3.7	12.5 ± 3.4	16
Emotion management	7.3 ± 3.5	9.8 ± 3.2*,†	5.7 ± 3.3	6.3 ± 3.7	12
Exercise	6.0 ± 4.0	7.3 ± 3.4*,†	5.9 ± 4.0	5.8 ± 3.5	12
Tobacco consumption	7.6 ± 1.4	8.0 ± 0†	6.9 ± 2.4	7.2 ± 1.7	8
Alcohol consumption	6.6 ± 2.3	7.6 ± 1.2*,†	6.2 ± 2.7	6.7 ± 2.1	8
Diet	25.5 ± 5.7	29.7 ± 3.7*,†	24.6 ± 5.1	27.9 ± 3.9*	36
Total	66.5 ± 12.5	79.5 ± 10.0*,†	65.5 ± 11.5	71.7 ± 10.8*	100

Abbreviations: CHCM, conventional health-care model; MIM, multiple intervention model.
*$P<0.05$ versus baseline of the same cohort.
†$P<0.05$ versus same evaluation of the CHCM cohort.

Table 3 | Comparison of clinical and biochemical variables between patients of both cohorts

Variable	MIM (*N*=39)		CHMC (*N*=39)	
	Baseline	Final	Baseline	Final
Systolic blood pressure (mm Hg)	150 ± 25	140 ± 30*	157 ± 22	144 ± 21*
Diastolic blood pressure (mm Hg)	82 ± 11	77 ± 11*	83 ± 11	78 ± 9*
Body mass index (kg/m^2)	27.9 ± 4.4	27.0 ± 4.3*,†	29.6 ± 4.9	29.3 ± 5.5
Waist circumference (cm)	99 ± 11	96 ± 11*	100 ± 11	100 ± 12
HbA_{1C} (%)	10.2 ± 2.2	9.1 ± 2.4*	9.4 ± 2.3	9.6 ± 2.3
Cholesterol total (mg/dl)	202 (177–235)	194 (169–226)	196 (175–219)	195 (167–220)
HDL-cholesterol (mg/dl)	44 (38–54)	43 (36–52)	41 (35–47)	41 (35–49)
LDL-cholesterol (mg/dl)	122 (93–139)	116 (90–136)	110 (96–132)	112 (90–129)
Triglycerides (mg/dl)	177 (119–266)	166 (127–214)	174 (130–238)	180 (135–266)
Uric acid (mg/dl)	5.4 ± 1.7	5.7 ± 1.3	5.1 ± 1.7	5.6 ± 1.8*

Abbreviations: CHCM, conventional health-care model; HDL, high-density lipoprotein; LDL, low-density lipoprotein; MIM, multiple intervention model.
*$P<0.05$ versus baseline of the same cohort.
†$P<0.05$ versus same evaluation of the CHCM cohort.

decreased only in MIM, whereas it remained unchanged in CHCM (Figure 1).

Clinical competence of FPs

Thirty-seven FPs participated, 16 in MIM and 21 in CHCM. All of them completed the educational intervention and no differences were found in terms of age (47 ± 5 vs. 44 ± 7 years, respectively), gender (female 75% vs. 68%, respectively), and years of work experience (17 ± 6 vs. 17 ± 7, respectively). At baseline, FPs of MIM had regular anticipated clinical competence in 38%, low in 56%, and very low in 6%; after the course, these findings significantly ($P<0.05$) improved to regular level in 44%, low in 50%, and very low in 6%. FPs of the CHCM had a baseline clinical competence of regular level in 37%, low in 53%, and very low in 10%; their final competence significantly increased ($P<0.05$) to regular in 74%, low in 21%, and very low in 5%. No significant differences were observed between FPs of both cohorts, either at baseline or at the end of the educational intervention.

Medical treatment results

Comparing the *baseline* versus *final* evaluations, patients of both cohorts significantly increased ($P<0.05$) the number of antihypertensive drugs used (MIM 0.84 ± 0.72 vs. 0.95 ± 0.77; CHCM 1.0 ± 0.65 vs. 1.31 ± 0.73), and had a non-significant trend to increase the use of angiotensin-converting enzyme inhibitors (MIM 47% vs. 53%; CHCM 56% vs. 61%) and angiotensin receptor blockers (MIM 5% vs. 13%; CHCM 10% vs. 20%). The final number of antihypertensives was significantly ($P<0.05$) higher in CHCM than in MIM. Both cohorts significantly ($P<0.05$) increased the use of aspirin (MIM 38% vs. 89%; CHCM 46% vs. 66%) and decreased the use of other non-steroidal anti-inflammatory drugs (MIM 56% vs. 23%, $P<0.05$; CHCM 61% vs. 31%, P not significant) at the end of the study. There was an increase in the number of lipid-lowering drugs used (including statins and fibrates) in both cohorts (MIM 0.42 ± 0.76 vs. 0.84 ± 0.88; CHCM 0.34 ± 0.66 vs. 0.55 ± 0.79), but this was statistically significant ($P<0.05$) only in the case of patients in MIM. Antidiabetic drugs (including insulin and oral hypoglycemiants) displayed only a non-significant trend to increase in both cohorts (MIM 1.61 ± 0.55 vs. 1.71 ± 0.65; CHCM 1.82 ± 0.68 vs. 1.92 ± 0.66).

DISCUSSION

Given the magnitude, implications, and cost of end-stage renal disease for both patients and health systems, strategies to counteract this problem in the very early phases are important and welcome. Application of several nephroprotective strategies and their positive impact on renal function in the early stages of CKD have been demonstrated when FPs received adequate training in the primary health-care setting.[6] However, the challenge is to modify negative lifestyle and dietary patterns in at-risk populations (as in the present study), as these could, directly or indirectly (through comorbid

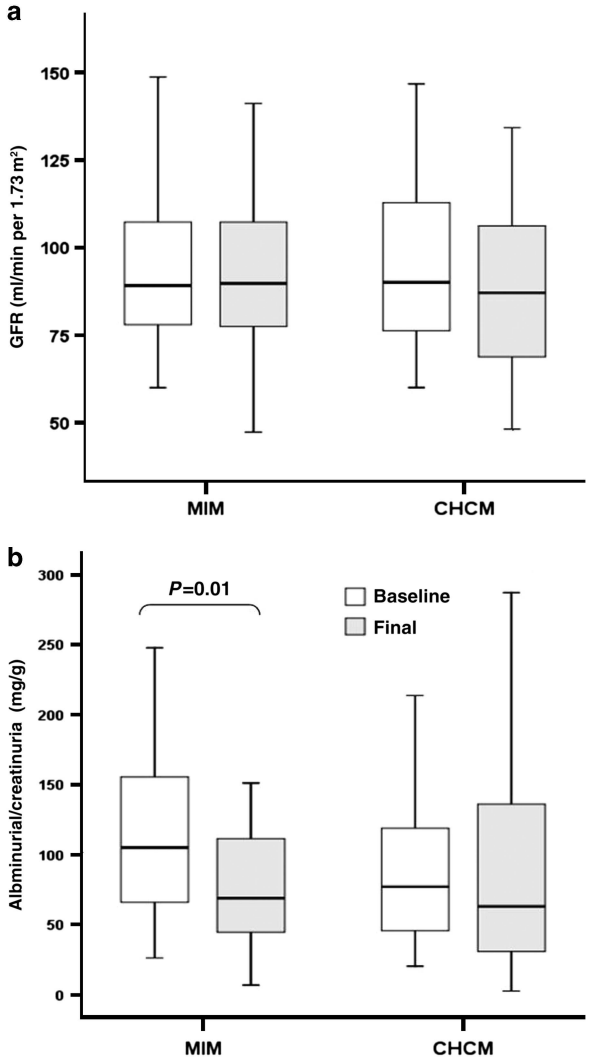

Figure 1 | Comparison of renal function at baseline and at the end of the follow-up. Comparison of GFR (**a**) and albuminuria/creatinuria ratio (**b**) between cohorts at baseline and the end of the follow-up.

events associated with CKD), eventually impact on kidney function.[14] The importance of modifying an unhealthy lifestyle is obvious,[15] and the use of multidisciplinary approaches for this purpose is well recognized in the primary health-care setting.[16] In recent years, there has been a growing interest in the use of multidisciplinary strategies to delay the progression of CKD. Results, however, have been contradictory. Some studies have failed to demonstrate improvement in renal function, mortality, or control of risk factors with the employment of multidisciplinary teams in patients with stages 3–5 of CKD,[17–19] whereas others have shown a better survival[20] or slower decline in GFR[21] compared to patients receiving usual care, although, in the case of the latter study, this effect was not associated with significant improvement of blood pressure, HbA_{1C}, or LDL cholesterol that could explain the better preservation of renal function. Our results showed that a MIM based on an educational program for patients, guided by a multidisciplinary health team, and supported by self-help groups is superior to CHCM in improving lifestyle habits, preserving renal function, and reducing albuminuria in patients with DM2 and early CKD. There are several differences between previous studies and ours. First, all the previous studies[17–21] were focused on patients with stages 3–5 of CKD (intermediate and late CKD), whereas the present study was confined to patients with CKD stages 1 and 2 (early nephropathy), which are the stages when nephroprotective maneuvers are more likely to be effective.[22] Second, we measured both the actions performed by patients to improve lifestyle habits as well as clinical–biochemical–renal function variables. We demonstrated concurrent changes in both measurements, as well as appropriate changes in medical treatment, strongly suggesting a causal relation between the multidisciplinary approach, the educational intervention, and these results. Third, appropriate information to manage CKD was available on-line for all health professionals participating in the study; moreover, all physicians participated in the educational intervention, and a significant increase in their clinical knowledge was demonstrated. In fact, FPs in the CHCM tended to have a greater increase in clinical competence than FPs in the MIM, which may further emphasize the positive impact of the comprehensive nature of MIM on patients. Additionally, the MIM employed in the present study included multiple and complementary strategies that could potentiate the positive impact on patients:[23] educational intervention, self-help groups, and dynamic follow-up, all of these strategies guided and supported by a multidisciplinary team. Limitations of the study are the relatively small number of patients included and the short follow-up period; completion of the present and further studies would help to support our results. In addition, further multicenter studies are necessary to evaluate the external validity of our results and consider their applicability to other national or international settings.

In conclusion, a MIM achieves a better control of lifestyle-related variables in DM2 patients with stages 1 and 2 of CKD, which are not modified by physicians acting in a CHCM. It is also important to adequately train primary health-care professionals in the management of early CKD. Broadly, implementation of a MIM in a primary health-care setting may have better results than CHCM in avoiding or slowing the progression of CKD.

DISCLOSURE

All the authors declared no competing interests.

ACKNOWLEDGMENTS

We appreciate the kind help of Adolfo Cota in processing laboratory samples. Publication of this article was supported in part by the National Health and Medical Research Council of Australia through an Australia Fellowship Award (#511081: theme Chronic Disease in High Risk Populations) to Dr Wendy Hoy, School of Medicine, the University of Queensland, and the National Institutes of Health—NIDDK DK079709, NCRR RR026138, and NIMHD MD000182. This work was partially funded by a grant (03-007) from the ISN COMGAN Research & Prevention Committee.

REFERENCES

1. United States Renal Data System 2011. http://www.usrds.org/2011/pdf/v2_ch012_11.pdf (accessed 23 December).
2. Barsoum RS. Chronic kidney disease in the developing world. *N Engl J Med* 2006; **354**: 997–999.
3. Go AS, Chertow GM, Fan D *et al.* Chronic kidney disease and the risks of death, cardiovascular events, and hospitalizations. *N Engl J Med* 2004; **351**: 1296–1305.
4. Tonelli M, Wiebe N, Culleton B *et al.* Chronic kidney disease and mortality risk: a systematic review. *J Am Soc Nephrol* 2006; **17**: 2034–2047.
5. Cueto-Manzano AM, Cortes-Sanabria L, Martínez-Ramírez HR *et al.* Detection of early nephropathy in Mexican patients with type 2 diabetes mellitus. *Kidney Int* 2005; **68**(Suppl 97): S40–S45.
6. Cortés-Sanabria L, Cabrera-Pivaral CE, Cueto-Manzano AM *et al.* Improving care of patients with diabetes and CKD: a pilot study for a cluster-randomized trial. *Am J Kidney Dis* 2008; **51**: 777–788.
7. Martínez-Ramírez HR, Cortes-Sanabria L, Rojas-Campos E *et al.* How frequently the clinical practice recommendations for nephropathy are achieved in patients with type 2 diabetes mellitus in a primary health-care setting? *Rev Invest Clin* 2008; **60**: 217–226.
8. Martínez-Ramírez HR, Jalomo-Martínez B, Cortés-Sanabria L *et al.* Renal function preservation in type 2 diabetes mellitus patients with early nephropathy: a comparative prospective cohort study between primary health care doctors and a nephrologist. *Am J Kidney Dis* 2006; **47**: 78–87.
9. Cueto-Manzano AM, Martínez-Ramírez HR, Cortés-Sanabria L. Management of chronic kidney disease: primary health-care setting, self-care and multidisciplinary approach. *Clin Nephrol* 2010; **74**(Suppl 1): S99–S104.
10. Levey AS, Coresh J, Greene T *et al.* Using standardized serum creatinine values in the Modification of Diet in Renal Disease Study equation for estimating glomerular filtration rate. *Ann Intern Med* 2006; **145**: 247–254.
11. López-Carmona JM, Ariza-Andraca RC, Rodríguez-Moctezuma JR *et al.* Construcción y validación inicial de un instrumento para medir estilo de vida en pacientes con diabetes mellitus tipo 2. *Salud Publica Mex* 2003; **45**: 259–268.
12. Guía de la Práctica Clínica Prevención Diagnóstico y Tratamiento de la Enfermedad Renal Crónica Temprana; Secretaría de Salud, México. 2009. http://www.cenetec.salud.gob.mx/descargas/gpc/CatalogoMaestro/335_IMSS_09_Enfermedad_Renal_Cronica_Temprana/GRR_IMSS_335_09.pdf (accessed 25 December 2011).
13. Cabrera PC, Chávez SA, González RH *et al.* Valoración global de la aptitud clínica de médicos familiares en el manejo de la diabetes mellitus con nefropatía inicial. *Rev Invest Clin* 2005; **57**: 685–690.
14. De Francisco AL, Fernández FG, Palomar R *et al.* The renal benefits of a healthy lifestyle. *Kidney Int* 2005; **68**(Suppl 99): S2–S6.
15. World Health Organization. *Global Strategy on Diet, Physical Activity and Health* http://www.who.int/dietphysicalactivity/strategy/en/.
16. Wagner EH. The role of patient care teams in chronic disease management. *BMJ* 2000; **320**: 569–572.
17. Harris LE, Luft FC, Rudy DW *et al.* Effects of multidisciplinary case management in patients with chronic renal insufficiency. *Am J Med* 1998; **105**: 464–471.
18. Isbel NM, Haluska B, Johnson DW *et al.* Increased targeting of cardiovascular risk factors in patients with chronic kidney disease does not improve atheroma burden or cardiovascular function. *Am Heart J* 2006; **151**: 745–753.
19. Barret BJ, Garg AX, Goeree R *et al.* A nurse-coordinated model of care versus usual care for stage 3/4 chronic kidney disease in the community: a randomized controlled trial. *Clin J Am Nephrol* 2011; **6**: 1241–1247.
20. Hemmelgarm BR, Manns BJ, Zhang J *et al.* Association between multidisciplinary care and survival for elderly patients with chronic kidney disease. *J Am Soc Nephrol* 2007; **18**: 993–999.
21. Bayliss EA, Bhardwaja B, Ross C *et al.* Multidisciplinary team care may slow the rate of decline in renal function. *Clin J Am Soc Nephrol* 2011; **6**: 704–710.
22. National Kidney Foundation. K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *Am J Kidney Dis* 2002; **39**(Suppl 1): S1–S266.
23. Coulter A, Ellins J. Effectiveness of strategies for informing, educating, and involving patients. *BMJ* 2007; **335**: 24–27.
24. Coleman MT, Newton KS. Supporting self-management in patients with chronic illness. *Am Fam Physician* 2005; **72**: 1503–1510.