ORIGINAL ARTICLE

Effectiveness of Multidisciplinary Care Team on Improving the Stages of Chronic Kidney Disease in Thailand

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Background: Because of the high prevalence of chronic kidney disease (CKD) in Thailand, the Ministry of Public Health implemented a policy with the concept of multidisciplinary care team (MDC) approach.

Objective: To evaluate the effectiveness of MDC in patients who received health service in CKD clinics.

Materials and Methods: The present study was a retrospective cohort study carried out among 1,059 CKD patients from 140 hospitals in 12 regional health districts of Thailand between April and July 2017. McNemar test was used to compare laboratory results and the stage changing of CKD before and after patients received the service by multidisciplinary care teams in CKD clinics.

Results: Seventy-four percent of subjects were aged more than 60 years. The average duration between the first and the last visit was 28.74 (range of 1 to 210) months. Mean estimated glomerular filtration rate (eGFR) on diagnosis CKD and last follow-up were 32.08±13.58 and 29.19±16.60 mL/minute, respectively. Mean systolic blood pressure on diagnosis CKD and last follow-up were 136.27±20.19 and 133.10±17.64 mmHg, respectively. Of the 1,059 patients, 15.5% improved the stage of CKD and 52.4% was stable. Stage of CKD, eGFR, blood pressure, creatinine, total cholesterol, triglyceride, and low-density lipoprotein cholesterol had statistically significant differences between before and after receiving health service from MDC in the CKD clinic.

Conclusion: MCD in CKD clinic had shown the effectiveness in improving the CKD stage and laboratory examination results among the CKD patients.

Keywords: Chronic kidney disease; CKD clinic; Multidisciplinary care team; Effectiveness of care

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Chronic kidney disease (CKD) is recognized as being highly prevalent in the population and is associated with morbidity and mortality relative to the general population[1]. The number of Thai in-patients by CKD according from health service units, Ministry of Public Health was rapidly increasing from 77,899 to 260,221 cases between 2003 and 2012[2]. The level of kidney disease was identified into five stages for providing care properly including tests and treatments[3]. Moreover, stages G5 should be further specified as dialysis. According to a community-based survey in Thailand, the prevalence of CKD stages 1 to 4 was 3.3%, 5.6%, 7.5%, and 1.1%, respectively[4]. Moreover, prevalence of CKD stage 3 to 5 in patients with hypertension was 33.2 and 4.3%, respectively[5], and in type 2 diabetes mellitus of 11.4% (range 9.7 to 13.4), 6.8% (range 5.5 to 8.5), 4.6% (range 3.5 to 6.0), and 1.6% (range 1.0 to 2.5) for stages 3A, 3B, 4, and 5, respectively[4]. The high prevalence of CKD in Thailand was mostly observed in less well-developed rural areas and the lowest in developed urban areas[6]. The ultimate goal of CKD management was to delay disease progression, prevent complications, and improve quality of patient life. The multidisciplinary care (MDC) programs have been proposed to alleviate the cost and morbidity associated with CKD in the United State[7].

MDC model has become an alternative way in clinical practice to achieve the CKD management goal in Thailand. The MDC model is an integrative

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team care system, encompassing a variety of disciplines by combining skills, knowledge, and experience to improve health care and achieve the best outcomes both the physical and psychosocial needs of patients[8]. A comprehensive MDC has been introduced as an alternate intervention to delay CKD progression in a community population. The previous study found that MDC can delay CKD progression in resource-limited settings[9]. The mean difference of estimated glomerular filtration rate (eGFR) over time in the MDC group was significantly lower than the traditional care by 2.74 mL/minute/1.73 m^2 ($p=0.009$)[9].

Because of the high prevalence of CKD in Thailand, the Ministry of Public Health of Thailand implemented a policy to set up CKD clinics to provide the services for CKD patients in all public hospitals. This was done in 2017, and the concept of MDC approach was emphasized. In the late decade, MDC approach was tested in Khlong Khlung Hospital, Kamphaeng Phet Province. It was successful thus it is now called the Khlong Khlung Hospital model[10] for CKD services. This model has six services provided by the kidney clinic including CKD screening, service system, MDC team, laboratory schedule setting, and data collection recording. The service by a MDC was composed of five disciplines, physician who provides standard treatment and reporting laboratory results linked to risk behaviors, nurse who provides CKD knowledge, screening, appointments and follow-up, coordinating referrals, and home visiting, pharmacist who reviews medication knowledge and drug labels, physical therapist who teaches and leads the appropriate exercises, and nutritionist who assesses and educates the nutritional status of the patients focusing on reducing salt and low protein diet. In addition, MDC also collaborated with networking in the areas such village health volunteers for taking care, following up, and home visiting. The work processes in CKD clinic were the activity to change the patients' behavior, promote to reduce salt intake, control the protein intake, enhance exercise, and home visit. The Ultimate goal of MDC in CKD clinics is to slow progression of CKD stage. Consequently, the purpose of the present study was to evaluate the effectiveness of MDC in patients who received health service in CKD clinics in Thailand.

Materials and Methods

Study design

A retrospective cohort study was conducted in 144 hospitals from seven levels of hospital in 12 regional health districts of Thailand. Among a regional health district, the hospital in each level was selected by simple random sampling. Seven levels of hospital in Thailand were determined as:

- Advance-level Hospital (A): a high referral hospital that had the capacity to accommodate patients who required specialized and complex treatments with the specialist physicians in all main majors,
- Standard-level Hospital (S): a standard referral hospital with the specialized, and complex treatments,
- Middle-level 1 Hospital (M1): a middle referral hospital with a complex and specialized treatment comprised of specialists in all majors,
- Middle-level 2 Hospital (M2): a 120-bed community hospital with 3 to 5 general practitioners or family physicians and specialists,
- First-level 1 Hospital (F1): a 90 to 120 bed community hospital with a general practitioner or family medicine doctor and a specialist,
- First-level 2 Hospital (F2): a 30 to 90 bed community hospital with 2 to 5 general practitioners or family medicine physicians, without specialists and operating rooms, and
- First-level 3 Hospital (F3): a community hospital with a size of 30 beds, with only 1 to 2 general practitioners or a family physician and a small operating room.

Sample and sampling

In the present study, a two-stage sampling process based on simple random sampling was used. Firstly, 144 hospitals were randomly selected from each of the seven levels of the hospitals: one Advance-level Hospital (A), one Standard-level Hospital (S), two Middle-level 1 Hospital (M1), two Middle-level 2 Hospital (M2), two First-level 1 Hospital (F1), two First-level 2 Hospital (F2), and two First-level 3 Hospital (F3). The inclusion criteria were the patients who were 3 to 5 CKD stage and aged more than or equal to 18 years old. The exclusion was the acute kidney injury patients. The stage 1 of CKD means a normal eGFR of 90 or greater and mild damage to kidneys, stage 2 CKD means that eGFR has gone down to between 60 and 89, stage 3 CKD is split into two sub stages based on eGFR: 3a has an eGFR between 45 and 59 and 3b has an eGFR between 30 and 44, stage 4 CKD means an eGFR between 15 and 29 and moderate to severe damage to kidneys, and stage 5 CKD means an eGFR less than 15 and severe damage to kidneys. Acute kidney

injury (AKI) is a condition in which the kidneys rapidly deteriorate and having one of the following characteristics: increasing in serum creatinine greater than or equal to 0.3 mg/dL within 48 hours, increasing in serum creatinine with greater than or equal to 1.5 times than the original expected abnormality occurred within the previous seven days, and urinary volume less than 0.5 mL/kg body weight for more than six hours. Secondly, eight patients were selected from these hospitals by accidental sampling within their visit to the CKD clinic. Finally, 1,152 CKD patients were required for the study and the final sample of the present study was 1,095 CKD patients. The response rate in the survey was 95.05%

Multidisciplinary care teams (MDC)

The MDC consisted of five professionals cooperated working with 1) doctors, 2) nurse case managers/coordinators, 3) nutritionists or those who have completed short-term training prescribed by the Ministry of Public Health, 4) pharmacist, and 5) physiotherapists or those who have completed short-term training prescribed by the Ministry of Public Health. Therefore, the patients would receive the treatment based on the concept of holistic care. The patients' treatment data were used to monitoring by the multidisciplinary team who would provide a suitable care plan and intervention in each patient. With these mechanisms, the MDC could reverse renal impairment (improved eGFR).

Data collection

One thousand fifty-nine CKD patients were included in the present study. The laboratory data were retrieved from the medical record or hospital database after receiving permission to collect the laboratory data from the medical records or databases. There were 119,149 CKD patients in the databases of the hospitals. The laboratory parameters were recorded on clinical record form (CRF) including blood pressure (BP), fasting plasma glucose/Dextrostix (FPG/DTX), serum creatinine, hemoglobin A1c (HbA1c), total cholesterol, triglyceride, low-density lipoprotein (LDL), and high-density lipoprotein (HDL). The data was collected on the first and the last visit. The average duration between the first and last visit was 28.74 months with a maximum of 210 months and a minimum of one month.

Data analysis

Data analyses were conducted using Stata, version 14 (StataCorp LP, College Station, TX, USA). The missing data was managed, and normal distribution of data was examined before analyses. The McNemar statistics were used to compare the stage change of CKD before and after service from CKD clinic. A p-value of 0.05 was considered statistical significance.

The study was approved by the Research Ethics Review Committee for Research Involving Human Research Participants (the 3rd Science group), Thammasat University, Pathum Thani Province, Thailand (Project number 003/2560, on April 20, 2017). The researchers explained the objectives of the present study. The participants had a right to refuse to join the study, and those who joined had to sign consent forms before enrolling in the present study.

Table 1. Baseline characteristics of participants (n=1,059)

Variable	Number (n)	Percentage (%)
Stage CKD (at first time in CKD)		
Stage 3a	218	20.59
Stage 3b	365	34.47
Stage 4	355	33.52
Stage 5	121	11.43
Age (years)		
≤60	275	25.97
>60	784	74.03
Mean±SD	67.63±12.27	
Comorbidity		
Hypertension	877	82.81
Diabetes Mellitus	670	63.27
Gout	141	13.31
Cardiovascular disease	81	7.65
Renal stone	23	2.17

CKD=chronic kidney disease; SD=standard deviation

Results

Demographic characteristics

The average age of the 1,059 participants was 67.63±12.27 years. The CKD prevalence of 3a, 3b, 4, and 5 stage was 20.59%, 34.47%, 33.52%, and 11.43%, respectively. The most comorbidities found in CKD patients were hypertension and diabetes mellitus (Table 1). Mean of eGFR on the first and last follow-up was 32.08±13.58 and 29.19±16.60 mL/minute/1.73 m², respectively. The achievement of blood pressure control as systolic pressure control (SBP) at or below 140 and diastolic pressure control (DBP) at or below 90 mmHg, at first time was 63.93% and at last follow-up was 70.54% (Table 2).

Table 2. Comparative laboratory examination at first time and last follow-up in CKD clinic

Laboratory examination	At first time	At last follow-up	p-value
Level of eGFR; n (%)			
≥90 mL/minute/1.73 m^2	0 (0.00)	6 (0.57)	
60 to 89 mL/minute/1.73 m^2	0 (0.00)	27 (2.55)	
30 to 59 mL/minute/1.73 m^2	570 (54.76)	447 (42.21)	
15 to 29 mL/minute/1.73 m^2	353 (33.91)	348 (32.86)	
<15 mL/minute/1.73 m^2 (renal failure)	118 (11.34)	231 (21.81)	
Mean±SD	32.08±13.58	29.19±16.60	<0.001
Level of SBP; n (%)			
≤120 mmHg	236 (22.67)	265 (25.41)	
121 to 130 mmHg	211 (20.27)	223 (21.38)	
131 to 140 mmHg	242 (23.25)	269 (25.79)	
>140 mmHg	352 (33.81)	286 (27.42)	
Mean±SD	136.21±20.19	133.10±17.64	<0.001
Level of DBP; n (%)			
≤80 mmHg	792 (76.08)	842 (80.73)	
>80 mmHg	249 (23.92)	201 (19.27)	
Mean±SD	75.19±12.63	72.25±11.30	<0.001
Blood pressure control			
SBP ≤140 and DBP ≤90 mmHg; n (%)	677 (63.93)	747 (70.54)	
SBP >140 and DBP >90 mmHg; n (%)	382 (36.07)	312 (29.46)	
FPG/DTX (mg/dL); mean±SD	146.12±71.99	135.79±58.14	0.005
Enz. creatinine; mean±SD	2.42±2.24	2.95±2.84	<0.001
HbA1c (%); mean±SD	8.02±2.39	7.81±2.61	0.162
Total cholesterol (mg/dL); mean±SD	197±53.46	185.25±47.01	<0.001
Triglyceride (mg/dL); mean±SD	196.20±131.26	176.91±101.49	0.005
LDL (mg/dL); mean±SD	113.83±47.42	106.19±51.98	0.002
HDL (mg/dL); mean±SD	49.70±25.25	49.22±21.28	0.702

eGFR=estimated glomerular filtration rate; SBP=systolic blood pressure; DBP=diastolic blood pressure; FPG/DTX=fasting plasma glucose/Dextrostix; LDL=low-density lipoprotein; HDL=high-density lipoprotein; SD=standard deviation

Table 3. Changes in stage of CKD after receive service from MDC

CKD stage at first time	Stage of CKD at last follow-up; n (%)						p-value
	1	2	3A	3B	4	5	
3A	2 (0.9)	20 (9.2)	86 (39.4)	66 (30.3)	34 (15.6)	10 (4.6)	0.022
3B	2 (0.5)	5 (1.4)	49 (13.4)	184 (50.4)	107 (29.3)	18 (4.9)	
4	1 (0.3)	2 (0.6)	8 (2.3)	52 (14.6)	187 (52.7)	105 (29.6)	
5	1 (0.8)	0 (0.0)	1 (0.8)	1 (0.8)	20 (16.5)	98 (81.0)	

CKD=chronic kidney disease

CKD stage changing after receive service from MDC

The state improvement is defined as the change of increasing eGFRs. The results showed that out of 1,059 patients, 164 (15.5%) improved the stage of CKD and 555 (52.4%) were stable. Stage of CKD, eGFR, blood pressure, creatinine, total cholesterol, triglyceride, and low-density lipoprotein cholesterol had statistically significant differences between before and after receiving health service from MDC in the CKD clinic (Table 2, 3).

After receiving the services from MDC, between 25% and 38% CKD patients had an increase of eGFR and between 5% and 16% were stable However, eGFR of patients with stage 3A, stage 3B, and stage 4 that decreased more than 10% was 42.23%, 21.98%, and 18.70%, respectively, with the average time between first and last visit of 37.10 months (Table 4).

Table 4. Number of patients had eGFR value changing in each stage of CKD

eGFR changing	Average month of first and last visit	Stage 3A; n (%)	Stage 3B; n (%)	Stage 4; n (%)	Stage 5; n (%)
Increasing	25.39	52 (25.24)	128 (35.16)	126 (35.69)	45 (38.14)
Stable	23.98	13 (6.31)	20 (5.49)	23 (6.52)	19 (16.10)
Decreasing 1% to 2%	22.47	10 (4.85)	33 (9.07)	33 (9.35)	24 (20.34)
Decreasing 3% to 4%	29.73	9 (4.37)	32 (8.79)	37 (10.48)	11 (9.32)
Decreasing 5% to 6%	27.43	15 (7.28)	23 (6.32)	23 (6.52)	7 (5.93)
Decreasing 7% to 8%	28.06	13 (6.31)	27 (7.42)	24 (6.80)	3 (2.54)
Decreasing 9% to 10%	30.13	7 (3.40)	21 (5.77)	21 (5.95)	5 (4.24)
Decreasing >10%	37.10	87 (42.23)	80 (21.98)	66 (18.70)	4 (3.39)

eGFR=estimated glomerular filtration rate

Discussion

The CKD prevalence of the present study in each of CKD level is higher than the previous study in year 2020. That study found the CKD prevalence of Stages 1, 2, 3, and 4 were 3.3%, 5.6%, 7.5%, and 1.1%, respectively, with the mean age of 45.2 years[4]. However, in the present study, the average age of the participants was 67.63±12.27 years. The population was the aging group while another study was the working age group. This might affect the prevalence.

The most comorbidity in CKD patients in the present study were hypertension and diabetes mellitus. The National Kidney Foundation specify the two main causes of CKD are diabetes and high blood pressure[3,11]. Similarly, the other study displayed that diabetes mellitus is a strong risk factor for CKD and end-stage renal disease[12]. Moreover, it was found that hypertension causes CKD[11].

The retrospective cohort study in Taiwan between 1997 and 2005 of 63,680 individuals that received health check-ups at the MJ Health Screening Center, found that there were 8,252, 1,634, and 6,714 participants who developed hypertension, type 2 diabetes mellitus and CKD, respectively. These three metabolic syndrome components showed the strongest association, elevated blood pressure with hypertension (HR 3.62, 95% CI 3.46 to 3.79), raised fasting plasma glucose with type 2 diabetes mellitus (HR 8.89, 95% CI 7.86 to 10.06), and elevated triglycerides with CKD (HR 1.14, 95% CI 1.08 to 1.21). Metabolic syndrome may help identify individuals with metabolic profiles that confer incremental risks for multiple diseases[13].

From the comparative of laboratory examination at first time and last follow-up in CKD clinic, it was found that blood pressure, creatinine, total cholesterol, triglyceride, and low-density lipoprotein cholesterol had significantly decreased between before and after receiving health service from MDC in the CKD clinic. The present study also found that eGFR had improved. The previous study from the United States showed that MDC was found effective for various chronic diseases such as cancer[14]. MDC refers to the professional team from a range of disciplines that work together to deliver comprehensive care addressing the patient's needs as much as possible. This concept offers a unique approach to the management of patients with cancer and helps deliver advanced patient care coordination and optimize a complex treatment plan in a physiologically active and highly morbid anatomically setting[15]. Moreover, MDC in diabetes and hypertensive patients significantly improved clinical and laboratory parameters, despite the ageing of population evaluated[16]. Regardless of the lack of standardization among MDC, all reported literature supports a positive relationship between improved care coordination, adherence to clinical guidelines, reduced time to treatment, and improved survival[15].

MDC consisted of physician, nurse, nutritionist, physical therapist, and pharmacist. The effectiveness might be found in the treatment and services, for example, providing CKD knowledge, appointments and follow-up, home visiting, medication knowledge, appropriate exercises, nutritional status focusing on reducing salt and low protein diet that could help change the patients' behavior and could lead to the improvement of eGFR.

Another study from the United States[7] compared a theoretical Medicare-based MDC program for CKD and a usual CKD care in Medicare beneficiaries with stage 3 and 4 CKD between 45 and 84 years old in the United States composing of nephrologists, advanced practitioners, educators, dieticians, and social workers. The result revealed that MDC could yield greater improvements in health among younger than older patients. This model could prolong life expectancy and meet conventional cost-effectiveness

thresholds in middle-aged to elderly patients with mild to moderate CKD[12]. The study from Thailand found that the integrated care in patients with CKD stage 3 and 4 in Thai rural communities was not cost-effective when compared with the standard care based on World Health Organization's recommendation criteria[17].

The kidney clinic of Khlong Khlung Hospital could significantly reduce the deterioration of renal function, resulting in the slow decline of eGFR at less than 4 mL/minute/1.73 m² after two years. The patients were able to control their blood sugar and lipids more effectively despite the severity of their blood pressure and BMI. The stability of stages 3 and 4 exceeded 70%[10]. Moreover, the effect of food control program for CKD patients applying the theories of self-efficacy at CKD clinic, Phra Nakhon Si Ayutthaya Hospital in Thailand was found to be effective in changing perceived self-efficacy in food control, outcome expectations of food control, and food control behavior[18,19].

The limitations of the present study were that the authors did not analyze patient characteristics across the levels of the hospitals. The level of hospital affected the treatment outcome. Consequently, the level of care should be accounted for improving the quality MDC and treatment of CKD patients under the different of resources in each hospital level.

Conclusion

From the results, the authors found that the health services provided by MDC could improve the overall laboratory examination results and stage changing including the increase of eGFR. The contribution of MDC, for example, each health professional complies as the team for taking care of CKD patients including improving CKD knowledge, follow-up, home visiting, medication knowledge, appropriate exercises, nutritional status, and changing CKD patients' behaviors. The present study is expected to help with the implementation of MDC in the CKD clinics as well as help the MCD patients to receive effective health care services.

What is already known on this topic?

Previous studies showed that the effectiveness of MDC was found in various chronic diseases. MDC could yield greater improvements in health among younger than older patients and could prolong life expectancy in middle-aged to elderly patients with mild to moderate CKD.

What this study adds?

MDC could improve the overall laboratory results and stage changes including the increase of eGFR. This study also found that blood pressure, creatinine, total cholesterol, triglyceride, and low-density lipoprotein cholesterol had significantly decreased between before and after receiving health service from MDC in the CKD clinics.

These findings support the idea that MDC provides effective health care services among CKD patients.

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Conflict of interest

The authors declare no conflict of interest.

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