ผลการใช้แนวทางการรักษาทางยาร่วมกันระหว่างแพทย์และเภสัชกรต่อการควบคุมระดับน้ำตาลในเลือดในผู้ป่วยโรคเบาหวานที่มีภาวะไตเสื่อม ณ คลินิกเบาหวาน โรงพยาบาลทั่วไปแห่งหนึ่ง

Effects of Collaborative Drug Therapy Management Protocol Use for Controlling Blood Sugar levels of Patients with Diabetic Kidney Disease Visiting Diabetic Clinic of a General Hospital

นิพนธ์ต้นฉบับ

Original Article

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาผลการใช้แนวทางการรักษาทางยาร่วมกันระหว่างแพทย์และเภสัชกรต่อการควบคุมระดับน้ำตาลในเลือดของผู้ป่วยโรคเบาหวานที่มีภาวะไตเสื่อมระยะที่ 3 **วิธีการศึกษา:** การศึกษาเชิงทดลองชนิดกลุ่มเดียวแบบวัดผลก่อนหลัง โดยเภสัชกรใช้แนวทางฯ ที่ตกลงร่วมกับแพทย์ในการดูแลผู้ป่วยโรคเบาหวานที่มีไตเสื่อมซึ่งควบคุมน้ำตาลในเลือดไม่ได้ 30 ราย ติดตามค่าน้ำตาลในเลือดสะสม น้ำตาลหลังอดอาหาร และค่าการทำงานของไตเป็นระยะเวลา 6 เดือน **ผลการศึกษา:** เมื่อจบการศึกษาเดือนที่ 6 ค่าเฉลี่ยน้ำตาลในเลือดสะสมของผู้ป่วยเท่ากับร้อยละ 7.21 ± 0.74 ลดลงจากค่าเริ่มต้น 8.28 ± 0.79 อย่างมีนัยสำคัญทางสถิติ (*P*-value < 0.001) ซึ่งเข้าสู่เป้าหมายการรักษา 19 จาก 30 ราย (ร้อยละ 63.33) หลังได้รับการดูแลจากเภสัชกรผู้ป่วยมีความพึงพอใจโดยรวมอยู่ในระดับมากที่สุด (ค่าเฉลี่ย 4.61 ± 0.36) **สรุป:** การดูแลโดยใช้แนวทางการรักษาทางยาในผู้ป่วยเบาหวานที่มีภาวะไตเสื่อมช่วยให้ควบคุมน้ำตาลในเลือดได้ดีขึ้น เข้าสู่เป้าหมายการรักษามากขึ้น โดยผู้ป่วยมีความพึงพอใจต่อรูปแบบการดูแลมากที่สุด

คำสำคัญ: แนวทางการรักษาทางยา, เบาหวาน, ไตเสื่อม, แพทย์, เภสัชกร

Abstract

Objective: To study the effects of collaborative drug therapy management (CDTM) protocol for glycemic control in diabetic patients with stage 3 chronic kidney disease (CKD). **Methods:** In this one-group pre-post study, CDTM protocol by the pharmacist was tested in 30 uncontrolled patients with stage 3 CKD. HbA1C, FPG and renal functions were monitored for 6 months. **Result:** At the end of the study, HbA1C significantly decreased from baseline (7.21 ± 0.74 to 8.28 ± 0.79%, *P*-value < 0.001). The 19 of 30 patients (63.33%) achieved a target of glycemic control. They were strongly satisfied with the CDTM care (mean score 4.61 ± 0.36 points). **Conclusion:** The CDTM protocol could improve glycemic control and achieve the target in diabetic patients with poor glycemic control and stage 3 CKD. It was highly satisfactory.

Keywords: collaborative drug therapy management, diabetes, renal impairment, physician, pharmacist

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Introduction

Diabetes has been a major public health problems with an increasing trend worldwide.[1] More than 50% of diabetes patients have poor glycemic control according to their target blood glucose.[2] Kidney disease is the most frequent complication of poor glycemic control.[3] About 34% of kidney disease is related with diabetes.[4] At Phrachomklao Hospital, Phetchaburi, Thailand, continuous, poor glycemic control was found in 50% of diabetes patients. As a result, rate of the progression to stage 3 chronic kidney disease (CKD) has been increasing. Medical care for this group of patients has been however limited. With a ratio of physicians to patients of 1:75, physicians could spend only 3 minutes with each of these diabetic patients at the out-patient department. In addition, with a constant monthly rotation of physicians, continuity of care cannot be achieved. As a result, more patients have poor glycemic control.

With the attempt to achieve a better glycemic control, hospitals have tried various interventions. The best method is the adjustment of the healthcare team or team change. The extension of healthcare team members' responsibility in patient monitoring and therapeutics adjustment has been proved to be efficient.[5] Collaborative drug therapy management (CDTM) between physicians and pharmacists is one of such platforms for patient care. CDTM is achieved under the agreement between physicians and pharmacists on

drug therapy starting with drug therapy initiation, adjustment, and continuation under the mutually agreed protocol.[6]

In Thailand, studies indicated that CDTM helped significantly improve fasting plasma glucose level. [7,8] Patients received CDTM had a more frequent drug dosage adjustment than those patients receiving the usual care. In Thailand and worldwide, most diabetes patients with poor glycemic control are involved in clinical inertia[9,10] which could lead to more CKD progression. CDTM as an intensive treatment modality could alleviate such clinical inertia. Since longstanding diabetes is usually associated with the massive defects of beta-cells, sole diet control with inadequate therapeutic drug dosage adjustment may not help the patient achieve their target glycemic control and progression rate to CKD is accelerated. An early achievement of target glycemic control could help decelerate the CKD progression in the long run.

With the concern on the renal complication in diabetes patients with poor glycemic control, the researcher with the collaboration with physicians had developed the CDTM-based care for drug therapy management in diabetic patients with CKD. The ultimate goal was to slow the further CKD progression. This research aimed to examine the effect of the CDTM-based care on glycemic control among diabetes patients with stage 3 CKD. Patient's satisfaction toward the CDTM-based care provided by pharmacists. Specifically, it was hypothesized that (1) the patient's HbA1C level and fasting plasma glucose (FPG) level after receiving CDTM-based care were lower than those before the care, (2) a higher number of patients with HbA1C within target level than that before the CDTM-based care, and (3) estimated glomerular filtration rate (eGFR) level after receiving CDTM-based care was higher or equal to that before the care. Glycemic control based on HbA1C was defined as HbA1C $\leq$ 8.0% for patients aged 65 years or older, and $\leq$ 7.0% for those aged < 65 years.

In the CDTM-based care, diabetes patients were taken care of with the following investigation and management. The patients were instructed to fast at least 8 hours before blood chemistry investigation. Effectiveness of drugs for lowering blood glucose and safety of the drugs were assessed. Dose appropriate for the patient's kidney function was evaluated. Dose adjustment and/or drug change were done according to the kidney function, drug's efficacy, safety, and cost. In the CDTM-based care, 3 drug therapy adjustments were defined. First, the adjustment with all pharmacist's recommendations accepted includes dose adjustment according to the [protocol within the maximum dose or continuation of the same drug with the maximum dose corresponding to the patient's kidney function. Second, the adjustment with only some pharmacist's recommendations accepted means dose adjustment according to the protocol within the maximum dose. Third, the pharmacist's recommendations rejected means drug regimen adjustment not according to the protocol such as adjusting dose over the maximum dose, or prescribing medications not in the protocol. In this research, clinical outcomes included HbA1C level, FPG after at least 8 hours fasting, eGFR and serum creatinine (SCr) level at months 3 and 6 (as dependent variables) after the patient received the CDTM-based care (as the intervention).

Methods

In this one-group pre-post study, benefits of collaboration between physicians and pharmacists on the CDTM-based care we examined by comparing the outcomes in the patients at months 0, 3 and 6 after receiving the care. The study was conducted at diabetes clinic of Phrachomklao Hospital, Petchaburi province, Thailand, from August 1, 2018 to July 31, 2019.

In the exploratory study, sample size was not estimated. Based on the concept of project testing, a minimum of 30 subjects were required.[11] In the actual study setting, with a laboratory test one day before the screening required, a very small number of patients could meet the inclusion and exclusion criteria. Therefore, the researcher included eligible patients resulting in 34 participants within the 5-month period. To be eligible, the patients had to be 35 years or older with the diagnosis of stage 3 CKD and type 2 diabetes. They also had to have an HbA1C level of 7% or higher and an FPG level of 150 mg/dl or higher. Those who were pregnant, had cancer or severe infection (i.e., AIDs, tuberculosis, etc), used insulin, lost to follow-up, referred to other healthcare setting, or had essential laboratory investigation results lost were excluded.

Research instruments

Two instruments were used in this study, CDTM-based care protocol and satisfaction questionnaire. The two instruments were developed by the researcher and tested for content validity by 3 experts (2 specialists in internal medicine and one pharmacist). The instruments were found to have an acceptable content validity with the Item Objective Congruence Index (IOC) of 0.83 by average.

CDTM-based care protocol

The protocol laid out the collaboration between physicians and pharmacists for the care of diabetes patients with stage 3 CKD. The protocol consisted of (1) preparation of the patients to the CDTM-based care (IOC = 0.86), (2) assessment of the efficacy of oral glucose lowering drugs (IOC = 0.87), (3) assessment of the safety of oral glucose lowering drugs (IOC = 0.95), (4) assessment of the dose of oral glucose lowering drugs according to kidney function (IOC = 0.67), (5) guidance for adjusting drugs or drug doses based on comparative efficiency, safety and cost (IOC = 0.67), (6) steps for adjusting doses of oral glucose lowering drugs according to kidney function (IOC = 0.67), (7) therapeutic monitoring strategy (IOC = 0.67). This protocol covered only 4 oral glucose lowering drugs (i.e., metformin, glipizide, pioglitazone and sitagliptin), insulin injection excluded. In performing the collaborative task, pharmacists communicated with physicians verbally to discuss about dose adjustment, opinions and approval for adjustment according to the protocol.

Satisfaction questionnaire

The questionnaire asked the patients about their satisfaction toward the CDTM-based care provide by pharmacists in various aspects including the promptness of the service, pharmacist service quality, therapeutic outcome quality, facilities and place. The questionnaire had a high content validity with an IOC of 1.00

Research procedure

Steps in providing the CDTM-based care were as follows. The researcher screen patients in advance based on laboratory investigation results (HbA1C, FPG, eGFR, and serum creatinine). These laboratory investigation was done one day before the usual follow-up appointment date. On the next day, the patients registered at the diabetes clinic as appointed and their weight, height were, and vital signs were measured and history of illness was examined by the nurse.

In the meeting with the pharmacist, medications reconciliation was performed by the pharmacist to check for any problems or inappropriateness in medications obtained from the hospital or other healthcare settings. The pharmacist reviewed medication use, evaluated patient's compliance on drug use, identified drug-related problems, and identified any factors interfering blood glucose level. Based on the information obtained, the pharmacist determined goal of drug therapy and planned therapeutic management accordingly as follows. The pharmacist reviewed HbA1C, FPG, maximum dose, and eGFR, compared efficacy, safety and cost of oral glucose lowering drugs. The pharmacist then evaluated the efficacy of the oral glucose lowering drugs the patient was using, accompanied with HbA1C level as guided by the protocol. Dose adjustment was done as guided by the protocol with drugs available in the hospital (metformin, glipizide, pioglitazone and sitagliptin). The pharmacist evaluated safety profile of the drugs the patient was using such as hypoglycemia, edema, etc. Finally, the pharmacist summarized drug therapeutic plan to present to the physician. The pharmacist reported the assessment to the physician in person. The physician followed the protocol and discussion with pharmacist about the patient evaluation and therapeutic plan. Opinions were exchanged and the mutual decision on therapeutic management was planned. Finally, the pharmacist planned laboratory investigation appointment, follow-up appointment, dispensing medications and provided medication use advice to the patient.

Data for research analysis were collected at the first visit with the initiation of CDTM-based care (month 0). Clinical outcomes data were collected at months 0, 3 and 6; while satisfaction data were collected at month 6. All other information in the usual care was collected at all visits between months 0 and 6, if any.

Human right protection

This study was approved by the Ethics Committee on Human Study of Naresuan University (IRB No. 259/60) and of Pharchomklao Hospital (Approval No. 13/2560). All patients were informed about the study and asked for permission to use their data for analysis. They were also informed about the voluntary nature of the study and their refusal to participate would not affect the care they received. Findings were presented as summary results.

Data analysis

Demographic and general clinical data of the patients were presented with descriptive statistics including mean with standard deviation and frequency with percentage. The changes of clinical outcomes which were continuous variables (HbA1C, FPG, eGFR and serum creatinine level) from month 0 to months 3 and 6, were tested with one-way repeated

ANOVA for normally distributed data and Friedman's test for non-normally distributed data. Statistical significance for all tests was set at a type I error of 5% (*P*-value < 0.05). Patient's satisfaction toward CDTM-based care was presented as mean with standard deviation. In addition to outcomes of the study objectives, acceptance of the physician toward recommendation on drug adjustment according to the protocol was presented as frequency with percentage. All statistical analyses were carried out using statistical software SPSS version 22.0.

Results

Of a total of 34 patients, four patients were excluded; one was suspected to have lung cancer, and three were with incomplete essential information. Of the 30 remaining patients, there were 146 visits, of which 116 were follow-up visits. There were slightly women (53.3%) than men. They were of 65 years of age by average. They were numbers of patients with stage 3a and 3b CKD equally. Their eGFR was 45.84 ± 9.4 ml/min/1.73 m^2 and HbA1C level of 8.3 ± 0.8% by average (Table 1).

Table 1 General characteristics of participants (N = 30).

Characteristics	N	%
Gender		
Male	14	46.67
Female	16	53.33
Age, yrs, (mean ± SD)	64 ± 8.9	
Underlying disease		
Diabetes and dyslipidemia	2	6.67
Diabetes, hypertension, and dyslipidemia	28	93.33
Duration of diabetes, yrs, (mean ± SD)	10.7 ± 4.3	
Duration of CKD, yrs, (mean ± SD)	3.77 ± 2.0	
Oral glucose lowering drugs		
Glipizide	1	3.33
Metformin + Glipizide	16	53.34
Glipizide + Pioglitazone	4	13.33
Metformin + Glipizide + Pioglitazone	9	30.00
Stage of CKD		
3a	15	50.00
3b	15	50.00
eGFR, ml/min/1.73 m^2, (mean ± SD)	45.84 ± 9.4	
SCr, mg/dL, (mean ± SD)	1.45 ± 0.32	
HbA1C, %, (mean ± SD)	8.3 ± 0.8	
FPG, mg/dL, (mean ± SD)	186.7 ± 35.7	

Note: eGFR = estimated glomerular filtration rate; SCr = serum creatinine level; FPG = fasting plasma glucose level

Dose adjustment of oral glucose lowering drugs according to kidney function

Based on the drug use evaluation at 146 visits, the over maximum dose of metformin was found 11 times. Pharmacists discussed with the physician to reduce the dose according to the kidney function to prevent lactic acidosis. Physicians agreed with all 11 incidents. Physicians also increased the dose of at least one oral glucose lowering drug according to the protocol. Drug with the most number of dose increase was glipizide (12 times) and pioglitazone (11 times). These increases were because metformin reached its maximum dose.

Acceptance of physicians toward adjustments according to collaboration between physicians and pharmacists

Of all 116 drug dose and frequency adjustment recommendations, the majority were all and partial recommendations combined (88 of 116 recommendations, or 75.86%) while the rest 28 recommendations (24.14%) were rejected (Table 2).

Table 2 Acceptance of physicians on pharmacist's recommendations on dose adjustment according to CDTM-based care protocol (116 recommendations).

Acceptance categories	N	%
All pharmacist's recommendations accepted: adjusting dose and frequency according to the protocol; continuing the under-maximum dose according to kidney function as guided by the protocol	78	67.24
Only some pharmacist's recommendations accepted: adjusting dose and frequency according to the protocol with under-maximum dose	10	8.62
Pharmacist's recommendations rejected: no dose or frequency adjustment according to the protocol	28	24.14
Total	**116**	**100.00**

Safety monitoring outcomes

Based on the 116 visits, adverse drug events were found 2 time with a triple therapy (metformin + glipizide + pioglitazone), one non-severe hypoglycemia corrected with decreasing a dose of glipizide and another edema with pioglitazone corrected by discontinuation of the drug and increasing another drug. The decrease of eGFR to be less than 30 ml/min/1.73m^2 or more than 5 ml/min/1.73m^2 which was an alarm sign of metformin use were found 8 times and incidents were reported to physicians for further proper dose adjustment.

Glycemic control outcomes

Based on the acceptance of 88 out of 116 dose adjustment recommendations (75.86%), mean HbA1C and

FPG at months 3 and 6 were lower than that at month 0 with statistical significance (Table 3). At month 6, there were 18 out of 25 patients (72.00%) achieving glycemic control based on HbA1C within target and their recommendations were completely and partially accepted by physicians. On the other hand, among 5 patients with their recommendations rejected by physicians, only 1 of them achieve glycemic control target (20.00%) (Table 4).

Table 3 Glycemic controls outcomes as HbA1C and fasting plasma glucose (FPG) at months 0, 3 and 6 based on the acceptance of 88 out of 116 dose adjustment recommendations.

Glycemic control outcomes	Mean ± SD			*P*-value
	Month 0	Month 3	Month 6	
HbA1C (%)	8.28 ± 0.79	7.43 ± 0.76[a]	7.21 ± 0.74[b,c]	< 0.001*
FPG (mg/dL)	186.70 ± 35.7	132.70 ± 30.2[d]	122.43 ± 18.1[e,f]	< 0.001†

* Overall one-way repeated ANOVA test.
[a] One-way repeated ANOVA pair-wise comparison between month 0 and month 3 (*P*-value < 0.001).
[b] One-way repeated ANOVA pair-wise comparison between month 0 and month 6 (*P*-value < 0.001).
[c] One-way repeated ANOVA pair-wise comparison between month 3 and month 6 (*P*-value = 0.014).
† Friedman test for overall comparison.
[d] Wilcoxon signed ranks test for pair-wise comparison between month 0 and month 3 (*P*-value < 0.001).
[e] Wilcoxon signed ranks test for pair-wise comparison between month 0 and month 6 (*P*-value < 0.001).
[c] Wilcoxon signed ranks test for pair-wise comparison between month 3 and month 6 (*P*-value = 0.075).

Table 4 Proportions of patients with achieving glycemic control based on HbA1C within target at month 6 (Number of patients = 30).*

Glycemic control based on HbA1C within target at month 6	Number of patients (%)	
	All and some recommendations accepted (n = 25)	Recommendations rejected (n = 5)
Target achieved*	18 (72.00)	1 (20.00)
Target not achieved	7 (28.00)	4 (80.00)
รวม	**25 (100.00)**	**5 (100.00)**

* Glycemic control based on HbA1C: ≤ 8.0% for patients aged 65 years or older, and ≤ 7.0% for those aged < 65 years.

Kidney function outcomes

Levels of both eGFR and SCr at month 0, 3 and 6 were comparable (Table 5).

Table 5 Kidney function outcomes at months 0, 3 and 6 (Number of patients = 30).

Kidney function	Mean ± SD (median)			*P*-value
	Month 0	Month 3	Month 6	
eGFR (ml/min/1.73 m^2)	45.84 ± 9.4 (46.68)	47.96 ± 11.0 (47.04)	46.88 ± 11.3 (44.60)	0.655*
SCr (mg/dL)	1.45 ± 0.3 (1.41)	1.41 ± 0.4 (1.39)	1.45 ± 0.4 (1.37)	0.984†

* Friedman's test; † one-way repeated ANOVA.

Satisfaction of the patients toward CDTM-based care by the pharmacist

Overall, the patients were highly satisfied with the CDTM-based care (mean score of 4.61 ± 0.36 points). The most satisfactory aspect was the service rendered by the pharmacist (mean score of 4.79 ± 0.37 points), followed by therapeutic outcomes of the service (mean score of 4.68 ± 0.38 points).

Discussions and Conclusion

Collaborative drug therapy management (CDTM) based care was approved by the physicians with a 75.86% of recommendations accepted. CDTM-based care helped improve glycemic control based on HbA1C and FPG significantly, which was evident at 3 and 6 month among diabetes patients with stage 3 CKD with poor glycemic control (*P*-value < 0.001). Since HbA1C decreased by 1% in this study, CDTM-based care could be beneficial in slowing progression of microvascular complications by 37%.[12]

The benefit on glycemic control of the CDTM-based care in this study was consistent with a trial examining CDTM-based care as a part of care for diabetes patients with poor glycemic control.[7] In that study, HbA1C at 1 year in patients receiving the CDTM-based care provided by the pharmacist decreased by 2% while those using usual care only had a decrease of 0.8%, resulting in a 1.2% difference with statistical significance (*P*-value < 0.01). However, patients in that study did not have CKD, study duration was longer, control group was included, and other care modalities to promote compliance and self-care were used in addition to the CDTM-based care and usual care. Yet, their study had the results comparable to ours.

Our finding was also consistent with a study examining the effect of CDTM-based care by pharmacists in type 2 diabetic patients.[8] They also found that in the experimental group, HbA1C decreased from 8.3% to 7.5% at 6 months (*P*-value < 0.001) and FPG decreased from 151.6 mg/dL to 128.3 mg/dL (*P*-value = 0.006). The study employed the proper control group.

Our study was comparable with a study of multidisciplinary care for CKD patients where pharmacists reviewed therapeutic management of the physician and laboratory results, identified drug related problems, recommended drug selection, dose adjustment according to kidney function, and

monitored efficacy and safety of drug therapy. [13] Pharmacists were allowed to discuss with and provide information to the physicians.[13] After 1 year, HbA1C decreased from 8.80% to 7.40% (*P*-value < 0.001). their finding was consistent with ours where HbA1C decreased from 8.28 ± 0.79% to 7.21 ± 0.74% (a mean decrease of 1%) and FPG decreased from 186.70 ± 35.7 mg/dL to 122.43 ± 18.1 mg/dL. These similarities could be due to similar characteristics of the patients of the two studies such as the elderly patients, risk factors of CKD (diabetes, hypertension, and HbA1C prior study). Differences between the two studies were that duration of diabetes and CKD in our study was longer, only stage 3 CKD patients were included in our study, the protocol was always used to adjust the dose of oral glucose lowering drugs according to the FPG in our study which could result in a 1% decrease of HbA1C within 6 months which was faster than the other study. However, in our study, eGFR and serum creatinine before and after the intervention were comparable (*P*-value =0.655 and 0.984, respectively).

The unchanged of these kidney function outcomes could be due to the patient's old age. Their age at the start of the study was 64 ± 8.9 years, duration of diabetes and hypertension of at least 5 years, duration of CKD of 3.77 ± 2.0 years, and a high proportion of macroalbuminuria (urinary albumin of more than 300 mg/gm) (56.7%). With a relatively duration of diabetes and a macroalbuminuria in these patients, their kidney moght not be changed in a short period of time.[14]

In addition to glycemic control to achieve the target, other factors to slow CKD progression in type 2 diabetic patients included limited consumption of salty food and limited consumption of protein of 0.6 – 0.8 gm/kg body weight in stage 3 CKD patients which could reduce the urinary protein. Salt should be limited to less than 2 gm per day. Smoking, holding urination, enforcing factors and encouragement from close individuals affect self-management in slowing CKD progression.[15] In our study, participants were provided with advice on food from nutritionist to confirm comparable knowledge about proper food consumption which could reduce variability about food consumption. One of the limitations in this study was that most participants were inconvenient to record food consumed and activities performed daily for the pharmacist to review. This could be due to their poor eyesight and living alone.

CDTM-based care with collaboration of physicians and pharmacists with the use of mutually agreed protocol helped the patients in adjustment of dose and frequency of oral glucose lowering drugs to achieve glycemic control. It also helped achieve the dose not exceeding the maximum dose, not overload the kidney function, to reduce the risk of adverse effects of the drugs excreted through kidney and accumulation such as metformin. It also reduced the clinical inertia resulting in more patients receiving dose adjustment according to the protocol. Proportion of patients achieving glycemic control was higher among those their drug doses were adjusted than those whose were not. The protocol could help adjust metformin dose according to the protocol so that adverse effect of the drug could be avoided.

This study had certain limitations. Small sample size limited the confidence in the results precision. This was because diabetic patients with stage 3 CKD are those with a long duration of diabetes and usually need insulin injection which made them ineligible for the study. The protocol did not have adjustment for insulin because it is a high-alert drug. A relative short duration of study (6 months) did not allow for sustainable and/or long-term effects of the care especially kidney function outcomes. Future study with longer study period and larger sample size should be conducted. Insulin should be incorporated into the protocol so that more patients with advanced diabetes could be included.

The protocol tested in our study could be applied in the care of type 2 diabetic patients with poor glycemic control and stage 3 CKD, without any others disorders or complications. The care should be conducted with multidisciplinary team for continuous patient care. Users should understand the protocol thoroughly especially on the adjustment on dose and frequency of 4 oral glucose lowering drugs including metformin, glipizide, pioglitazone and sitagliptin. All conducts should be mutually agreed by all professionals involving in the care of diabetic patients.

In conclusion, CDTM-based care with the collaboration of physicians and pharmacists for type 2 diabetic patients with poor glycemic control and stage 3 CKD resulted in a decrease in HbA1C and FPG to the target, while kidney function did not change. The patients were satisfied with the care at the higher level.

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