# Comparison of Outcomes of Patients with Diabetes Receiving Care by Way of Three Primary Care Practice Models

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**Abstract :** The study's purpose was to compare outcomes of care among patients, with type-2 diabetes, who were receiving care via three primary care practice models: a nurse practitioner-physician full-time model (NP-MD$^{f}$); a nurse practitioner-physician part-time model (NP-MD$^{p}$); and, an NP without a physician model (NP). Outcomes of diabetes care included glycemic control, self-care ability, satisfaction with care, and quality of life. Six primary care settings, in a province in central Thailand, were used as study sites, with each model implemented in two of the settings. A convenience sample of 300 participants, with type-2 diabetes,who were receiving care at the selected study sites, was recruited (100 for each model). Data were collected via the; Demographic Information Questionnaire (DIQ); Diabetic Self-Care Ability Questionnaire (DSCAQ); Patient's Satisfaction with Care Questionnaire (PSCQ); and, Diabetes Quality of Life Questionnaire (DQOLQ). Descriptive statistics and MANOVA, with Tukey's HSD, were used to analyzethe data.

Results indicated no significant difference, in the mean score of the fasting blood glucose level, was found among the subjects who received care via the three models. The mean scores of the DSCAA and DQOL of participants, receiving care via the NP-MD$^{f}$ and NP models, were significantly higher than those receiving care via the NP-MD$^{p}$ model. In addition, the mean scores of the PSA of participants, receiving care via the NP and the NP-MD$^{p}$ models, were significantly higher than those receiving care via the NP-MD$^{f}$ model.

The findings suggested that NP model can, provide care to individuals with type-2 diabetes of the same quality as NP-MD$^{F}$ and NP-MD$^{P}$ model. In addition, the results revealed the NP model was likely to achieve better psycho-social-behavioral outcomes than the NP-MD$^{f}$ and NP-MD$^{p}$ models.

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## Introduction

Healthcare reform, throughout Thailand, was initiated in 2001, with the goal of ensuring universal health care coverage for the all residents.[1]Achieving this goal involved improvement in the quality of services provided at the primary healthcare level, with recognition that primary care can be expected to lower the cost of care, improve health through access to more appropriate services, and reduce inequities in a population's health.[2] Having a regular primary

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healthcare provider is one of the best indicators that a person will receive appropriate comprehensive care, including: health promotion; disease prevention; early detection of illness; management of common health problems; management of chronic illness/conditions; and, rehabilitation.[3]

The Thailand Nursing and Midwifery Council (TNMC) envisioned that nurses should be at the forefront in providing primary healthcare. A review of studies, in Thailand and developed countries, has revealed that nurses are the major providers of primary healthcare services, particularly in remote areas.[3]Furthermore, there is strong evidence that appropriately-trained nurses and/or nurse practitioners have the ability to provide primary healthcare even in high-income countries (i.e., the United States of America[4] and the United Kingdom[5]).

In the midst of a severe physician shortage in Thailand, and while healthcare reform to ensure universal coverage was being initiated, the TNMC responded by building a nursing workforce, especially community health nurses, to expand the scope of nurses' primary care practice. This led to a formally-developed, post-basic, nurse practitioner (NP) program that consists of four months of training, after two years of clinical experience as a registered nurse (RN). The NPs are expected to work in primary care units to provide integrated services to those who live and work nearby.[3] The integrated services provided include: health promotion; disease prevention; disease detection; diagnose and treatment of common health problems; management of chronic illnesses/conditions; and, care of terminally-ill patients at home and in the community.

Currently, primary care practice models within Thailand are divided into three categories: [6]

- *Health centers without physicians: This model is a small community health center (CHC) serving the population at the sub-district and village level, with coverage of fewer than 5,000 people. One NP or one RN, and one to two community health workers are present.*

- *Health centers with physicians on rotation: This model is a large CHC, with coverage of 5,000-10,000 people. One to two NPs and two to four community health workers (CHW), including a dental assistant ordental hygienist, are present.*

- *Upgraded health centers with a "non-rotating" family medicine (FM) or general practice physician (GP): This model is referred to as a "Community Medical Unit" (CMU), with coverage to 10,000-15,000 people in the catchment area. At least one physician, two to three NPs, four to six CHWs, and a part-time or full-time dentist and dental hygienist are present. Very few CMUs are in large urban areas.*

As chronic illnesses, especially diabetes mellitus, have increased,worldwide, almost 50% of Thais who have diabetes receive care via a variety of primary care practice models:[6] the Nurse Practitioner-Physician full time (NP-MD$^{f}$) model; the Nurse Practitioner-Physician part-time (NP-MD$^{p}$) model; and the Nurse Practitioner (NP) model. However, no data is available for comparison, between the three models, of the outcomes of care of persons with diabetes.

## Literature Review

The NP's role, in Thailand, continues to develop in response to changing societal and healthcare needs, in all settings, to ensure universal healthcare coverage of the population. At present, NPshave an opportunity to perform primary care service, particularly in the rural and underserved communities. In clarifying their role in primary care, members of the profession are responsible for advancing the role of

the NP and ensuring that the standards of the profession are maintained. Outcomes research on their practice will allow NPs to improve health outcomes and quality of care. A number of NP-sensitive outcome measures have been identified, including clinical outcomes (i.e., health status, complications, and symptom reduction; knowledge of disease and its treatment;[7, 8] self-care abilities;[4, 7, 8] patient satisfaction and quality of life;[4, 9] and, cost of care.[4, 8, 9])

Prior studies have consistently supported the quality and cost-effectiveness of NP practice in a variety of practice areas (i.e. acute, chronic, and ambulatory care). A meta-analyses of NP outcomes[7, 8] and a review of NP effectiveness,[9] comparing the quality of care provided by NPs and MDs, revealed that NP outcomes and management of care were at least as good as that of physicians. A longitudinal study, in a primary care setting, among patients with diabetes, hypertension, and asthma, found no difference, at a two-year follow up, between patients followed by NPs or MDs, with respect to health status, physiological indicators, satisfaction with care, hospitalization, or utilization of health services.[10]

A number of studies have compared NP outcomes and those of physicians regarding patients with diabetes. One such study[11] showed that NPs and MDs had similar patient outcomes with respect to patients': blood pressure, blood glucose and creatinine testing, foot examination, and ophthalmologist referrals. However, the NPs were found to be more likely than the MDs to document general diabetes education and education regarding nutrition, weight and height, exercise, HbA1c, and medications. Additionally, positive NP-diabetic outcomes were demonstrated in an experimental study that compared patient outcomes of care between an experimental group of a MD-NP team and a control group receiving the usual MD-directed care.[12] The experimental group had a significantly shorter stay and, after adjustment for the cost of the team intervention, a significant net cost savings was associated with the use of the team. In addition, there were no differences in readmission rates, mortality, or patient satisfaction. The author implied, but did not specify, that the NPs employed in the study were acute care NPs. The NPs' role was to perform continuity of care to supplement physician care. However, they did not function fully as NPs, as they did not admit patients or prescribe medications.[12]

Within the primary care setting, the practice of NPs providing care to diabetics, compared to the care provided by physicians, showed the NPs' interventions lowered HbA1c and glucose to a greater degree than his or her physician colleagues.[13] Blood pressure of the patients cared for by the NPs and MDs remained equal. Diabetes patient education was initiated, documented, and offered throughout the continuum of care more consistently by the NPs than the MDs. The findings suggested the NPs were capable of performing a high level of expertise in clinical management and were dependent upon the clinical practice guidelines to achieve optimized outcomes (i.e. improving metabolic control and saving health care costs).

An evidence-based project[14] investigated whether the consistent care provided by NPs, in a free diabetic clinic, would match or exceed the voluntary but inconsistent care provided by MDs, in achieving the American Diabetes Association (ADA) guidelines for 2004-2009.[14] The results demonstrated that the NP visits and the volunteer MD visits did not differ statistically, regarding the patients' HbA1c, HDL, or LDL goal attainment. However, the ophthalmology and podiatry referrals, and microfilament testing were more frequently performed by the NPs than by the MDs.

Although the literature demonstrates that NPs perform a comprehensive range of practice, including expanded medical care practice (i.e. physical assessment and diagnosis, ordering laboratory tests, prescribing treatments), that is comparable to that of physicians, the need for outcome evaluation studies that provide reliable data to verify the impact of NP care still are desired. Such NP outcome research

hopefully would: make the results of Thai NP practices more visible to the healthcare system; lead to better understanding of NP contributions; and, provide rationale for development and expansion of an integrated NP role.

In addition, previous studies have revealed that the characteristics of NPs, such as clinical competency and provider performance, affect healthcare outcomes.[15] These characteristics are related to the NPs' experience and educational preparation. It must be kept in mind, however, that the referenced NPs were trained at the masters or doctoral level, and underwent rigorous assessment via a certificated examination to become an advanced practice nurse.[15] On the other hand, the NPs, throughout Thailand, are trained only for four months after a minimum of two years of clinical experience as an RN. Thus, evaluation of NP utilization, in various primary care practice models, throughout Thailand, is needed. Therefore the purpose of this study was to compare the differences in outcomes (i.e., glycemic control, self-care ability, satisfaction with care, and quality of life) among persons with diabetes receiving care at primary care settings, based on the NP-MD$^{f}$, NP-MD$^{p}$, and NP models.

## Method

***Design***: A descriptive comparative study design was used.

***Ethical considerations***: The study was approved by the Institutional Review Board (IRB) of the Primary Investigator's (PI) academic institution and the primary care units (PCUs) used as study sites. Potential participants were informed about: the purpose of the study;what study involvement entailed; voluntary participation; anonymity and confidentiality issues; and theright to withdraw, at any time, without repercussion. Those willing to participate were asked to sign a consent form before taking part in the study.

***Settings:*** Since one province, near Bangkok, Thailand, contained all three types of the primary care models (NP-MD$^{f}$, NP-MD$^{p}$, and NP), it was selected as the study site. Out of the 16 districts, in the selected province, six were chosen for inclusion because they meet the pre-determined criterion of having more than 100 registered patients with diabetes.

All three primary care practice models used the medical practice guideline for diabetes (B.E. 2551) set forth by the Thai National Health Security Office (NHSO).[16] In addition, they all provided five specific aspects of diabetic healthcare: screening and diagnosis of diabetes; treatment for glycemic control; follow-up and evaluation of treatment outcomes; complication screening; and, diabetic education for self-care and lifestyle adjustment.

In the NP-MD$^{f}$ model, a physician was responsible for the diagnosis, prescribing treatment, complication screening, and follow-up/evaluation of treatment outcomes for the patients with diabetes. The NP was mainly responsible for the patients' education for self-care and lifestyle adjustment, as well as assisting the physician in all other aspects of care.

In the NP-MD$^{p}$ model, both the NPs and the physicians provided medical care to the patients. The physicians routinely worked only two days a week, while the NPs examined and treated patients the other three days of the PCUs' weekly schedule. The physicians solely examined patients and prescribed treatments the two days they were present, while the NPs switched from providing total care to providing health education and screening for complications.

In the NP model, the NPs provided all five aspects of primary diabetic care in accord with the NHSO's diabetes' care guidelines.[16] The NPs referred the patients whose blood sugar could not be controlled to a higher level of care.

***Sample:*** A sample size of 315 (105 participants for each model), with a 5% attrition rate,was calculated through use of the Guilford and Fruchter's Table[17] (alpha = 0.05, p = 0.70, d = 0.5, c = 0.25, q2 = 0.125, and group = 3, variable = 4). Thus,

325 persons with type-2 diabetes mellitus were approached and invited to take part in the study. Twenty-five of them (7.69%) refused, mainly because of inconvenience to participate, leaving 300 participants (100 for each model). The inclusion criteria for participants included: being a Thai diagnosed with type-2 diabetes; being 18 years of age or older; receiving care at one of the selected PCUs for at least one year prior to data collection; and, having no known impairment in cognition or hearing.

The participants, who ranged in age from 27 to 82 years ($\bar{x}$ = 60.70), primarily were: female (n = 219; 73.0%); Buddhists (n = 271; 90.3%); primary school graduates (n = 262; 87.6%); married (n = 198; 66%);working (n = 171; 57.0%); receiving an income of less than 5,000 baht per month (n = 207; 69%); receiving the Universal Healthcare Coverage Scheme (n = 258; 86%); and, overweight (n = 174; 58%).

The average duration of being diagnosed with diabetes was 7.17 years (SD = 5.26), with 97.7% (n = 293) having no diabetic wounds and being controlled through use of oral diabetic medications (n = 277; 92.3%). Regarding risk behaviors, 9.3% (n = 28) smoked cigarettes and 8.3% (n = 25) consumed alcohol. Most had one or more co-morbidities, including hypertension (n = 206; 68.6%) and dyslipidemia (n = 169; 56.3%). None of the participants' characteristics were significantly different ($p$> .05).

***Instruments:*** Data were collected via testing capillary fasting blood glucose levels and administration of four questionnaires (Demographic Information Questionnaire (DIQ); Diabetes Self-Care Ability Questionnaire (DSCAQ;[20] Patient's Satisfaction with Care Questionnaire (PSCQ);[22] and Diabetic Quality of Life Questionnaire (DQOLQ).[23, 24] Fasting capillary blood glucose (FCBG) was measured through a glucometer because of its convenience and cost effectiveness. A prior study demonstrated that the FCBG test had an acceptable accuracy, with 94.2% sensitivity and 90.2% specificity, when compared to results from standard plasma glucose testing.[18] Hence, the average of the last three months of each subject's FCBG was used in this study. However, the FCBG test is known to likely value the blood glucose level more than the peripheral venous blood glucose measurement because the glucose in capillary blood is not fully delivered to the cells.[19] Interpretation of the FCBG values wereclassified, according to the NHSO's diabetes' care guidelines,[16] as: good (70-129.99 mg/dl); fair (130-149.99 mg/dl); or, poor (≥ 150 mg/dl).

The researcher-developed Demographic Information Questionnaire (DIQ)consisted of 14 items, including each subject's: age, gender, marital status, religion, education, occupation, income, healthcare financing, BMI; current risk behaviors (smoking and alcohol consumption); duration of diabetes; treatment regimen; co-morbidities; presence of diabetic wounds; and fasting capillary blood glucose.

The Diabetes Self-Care Ability Questionnaire (DSCAQ) was developed, based on the self-care needs of individuals with diabetes that were recommended by the Thai Association of Diabetes Educators,[20] as part ofthe Advanced Practice Nurse Outcomes Research Task Force of the Thailand Nursing and Midwifery Council.[21]The DSCAQ consisted of 36 items that addressed six dimensions: diet (14-items); exercise and activity (2-items); self-monitoring (4-items); information and follow-up (4-items); hygiene and foot care (9- items); and,medication taking routine (3-items). The participants were asked to respond, using the following rating scale, according to how often they performed each behavior: 0 = "never to rarely done (0 days per week or once in a while)"; 1 = "sometimes (1-3 days per week)"; 2 = "frequently (4-5 days per week)"; and, 3 = "always (6-7 days per week)". Examples of the questions were: *"How often do you eat desserts between meals?"* and *"How often do you examine your feet?"* Twenty-nine of the items were positively stated, while seven were negatively stated. Prior to

calculating the six dimension scores and total score, the negatively stated items were reverse scored. Dimension scores were calculated by summing the response values across all relevant items, while the total score, which could range from 0 to 108, was calculated by summing the response values across all items. A high total score meant having a higher ability to perform diabetes self-care. Interpretation of the total score was: high (score of 72-108); moderate (score of 36-71.99); or, low (score of 0-35.99). The content validity (CVI) of the DSCAQ was reviewed by five experts (two faculty members with expertise in diabetes care; one diabetic nurse educator; and, two advanced practice nurses in diabetic care). The CVI was found to be 0.83. Prior to use, the DSCAQ was pilot-tested on 30 patients with diabetes. Its reliability was found to be 0.83. For the actual study, the reliability was 0.87.

The Patient's Satisfaction with Care Questionnaire (PSCQ),[22] consisted of 15 items that measured patients' satisfaction with their providers' care in terms of the sub-dimensions of humanization (6 items), competency (2 items), and accessibility to diabetes care (7 items). Examples of the items were: *"I got explicit explanations regarding health through the health care provider (physician or nurse)"* and *"The health care provider (physician or nurse) performed mindful and attentive care for me." The p*articipants were asked to respond to the items on a 5-point Likert-like scale (1 = "very strongly disagree"; 2 = "somewhat disagree"; 3 = "neutral"; 4 = "somewhat disagree"; and, 5 = "very strongly agree"). Sub-dimension scores were obtained by summing the response values across all relevant items, while a total score, which could range from 15 to 75, was determined bysumming across all items. High scores meant better patient satisfaction with the healthcare received. Interpretation of the total PSCQ score was classified as: high (55-75); moderate (35-54.99); or, low (15-34.99). The reliability,in pilot-testing the PSCQ on 30 patients with diabetes, was 0.92. For this study, the reliability was 0.95.

The original version of the Diabetes Quality of Life Questionnaire (DQOLQ),[23] was published and available for public use. The DQOLQ was translated into Thai by Keeratiyutawong[24] and permission for usage was obtained. The questionnaire was divided in two sub-dimensions: satisfaction with life (15 items i.e., "How satisfied are you spending time to perform diabetes self-care?") and, life impact (10 items i.e., "How often do you have to stop working because of diabetes?"). Possible responses for the satisfaction with life items ranged from 5 = "very satisfied" to 1 = "very unsatisfied." Possible responses for the life impact items ranged from 5 = "disappeared" to 1 = always present." Eight of the life impact items required reverse scoring before calculating the total score. Sub-dimension scores were obtained by summing the response values across relevant items, while a total score was obtained by summing the numerical values of the responses across all items. Scores then weretransformed into a 100 point scale where zero represented the lowest possible quality of life and 100 represented the highest possible quality of life. This was accomplished by using the following formula:

$$\text{Transformed scale} = \frac{[(\text{raw score} - \text{lowest possible score})]}{\text{raw score range}} \times 100$$

A high score on each component of the DQOLQ suggested a positive quality of life. Interpretation of scores on the DQOLQ were classified as: high (75-100); moderate (50-74.99); and, 3) low (20-49.99).The reliability, in pilot-testing the DQOLQ on 30 persons with diabetes, was: 0.75 (life satisfaction = .77; life impact = .72). For the actual study,the reliabilities were 0.78 (life satisfaction = .79; life impact = .75).

***Procedure:*** After approval to conduct the study was granted, data were collected at each of the study sites. The PI introduced herself to the directors of the PCUs, the health care providers, and patients with diabetes, as well as explained the purposes and benefits

of the study to all of them. The PI reviewed the patient medical records on the days potential participants attended the diabetic clinic. Those who met the inclusion criteria were approached and invited to participate in the study. After an individual agreed to participate, the PI read theitems in each questionnaire to him/her. He/she would, in turn, verbally respond with the responses being recorded on the respective questionnaire. The questionnaires were administered in the following order: DIQ, DSCAQ, PSCQ, and DQOLQ. It took 45 to 50 minutes to complete all four questionnaires. The medical information for the DIQ (i.e., FCBG, presence of diabetic wounds, co-morbidities, type of treatment regimen, and duration of diabetes) was obtained from each subject's medical record.

***Data Analysis:*** The demographic data were analyzed using descriptive statistics. Differences on characteristics among the participants were tested using: $\chi^2$ for data on a nominal scale; Kruskal-Wallis for the interval and ratio scale with non-normal distribution; and, ANOVA for normal distribution. MANOVA was used to test the differences in the subjects'FCBG, DSCAQ, PSCQ, and DQOQL. If a significant difference was detected, a Tukey's HSD (honestly significant difference) test was performed to test the difference between different pairs of the models.

## Results

***Fasting Capillary Blood Glucose* (FCBG):** As shown in **Table 1**, participants receiving care via the NP model had the lowest mean for FCBG. However, the mean was close to the mean scores for FCBG of those receiving care via the NP-MD$^f$ model and the NP-MD$^p$model. MANOVA demonstrated no significant difference, among the participants receiving care via the three models, with respect to their mean FCBG. Upon considering the number of good, fair and poor controls, about 30% of the participants were found to be in good control, nearly half exhibited fair glycemic control, and approximately 20% showed poor glycemic control. Those receiving care via the NP-MD$^f$ model had the highest percent of good glycemic control and the lowest percent of poor glycemic control. On the other hand, those receiving care viathe NP-MD$^p$ model had the highest percentage of poor glycemic control. Additionally, $\chi^2$ showed no significant differences in glycemic control across the three models.

**Table 1** Comparison Fasting Capillary Blood Glucose among Participants Receiving Care via Three Primary Care Practice

| Dimensions of FBG | NP-MD$^f$ n=100 (%) | NP-MD$^p$ n=100 (%) | NP n=100 (%) | Total N=300 | F | *df* | *p-value* |
|---|---|---|---|---|---|---|---|
| **Total FBG** | | | | | .262 | (2, 297) | NS |
| Mean | 152.60 | 154.97 | 149.20 | 153.29 | | | |
| SD | 42.90 | 40.22 | 32.44 | 38.68 | | | |
| Min | 91.08 | 91.33 | 86.00 | 86.00 | | | |
| Max | 236.68 | 242.85 | 223.33 | 242.85 | | | |
| **Glycemic control** | n=100 | n=100 | n=100 | | | | |
| 1. Good (70-129.99mg/dl) | 33(33.0) | 31(31.0) | 30(30.0) | | .262 | (2, 91) | NS |
| 2. Fair (130-149.99 mg/dl) | 48(48.0) | 47(47.0) | 49(49.0) | | .057 | (2,141) | NS |
| 3. Poor control(≥ 150 mg/dl) | 19(19.0) | 22(22.0) | 21(21.0) | | .298 | (2, 59) | NS |

**Note:** FCBG = Fasting capillary blood glucose; NP = Nurse practitioner model; NP-MD square = Nurse practitioner-Physician full-time model; NP-MD square = Nurse practitioner-Physician part-time model; NS = Non-significant (p-value > .05)

***Diabetes Self-Care Ability* (DSCA):** As shown in **Table 2,** the level of the participants' diabetic self-care ability was moderate in all three models. However, those receiving care viathe NP model had the highest mean score of total DSCA and the four sub-dimensions of diet, exercise, follow up, and foot care. MANOVA showed a significant difference, among participants receiving care via all three models, in the mean scores of total DSCAQ, the sub-dimension of diet; and the sub-dimension of follow-up. Further analysis, using the Tukey's HSD test, showed that participants receiving care via the NP and NP-MD$^{f}$ models were not significantly different regarding their mean scores for the total DSC*AQ* ($p$> .05), while those receiving care viaboth models had significantly higher mean scores for the total DSCAQ than those receiving care viathe NP-MD$^{p}$ model ($p$< .05). For the sub-dimensions, there were significantly higher mean scores for diet and follow-up for those receiving care via the NP and NP-MD$^{f}$ models than those receiving care via the NP-MD$^{p}$ model ($p$< .05). However, no significant differences in the diet and follow-up mean scores were found between participants receiving care viathe NP and NP-MD$^{f}$ models ($p$> .05).

**Table 2** Comparison of Diabetes Self-Care Abilities among Participants Receiving Care via Three Primary Care Practice Models

| Dimensions of DSCA | NP - MD$^{f}$ n=100 | NP - MD$^{p}$ n=100 | NP n=100 | F | $df_1$, $df_2$ | *p-value* |
|---|---|---|---|---|---|---|
| **Total DSCA** | | | | 5.081 | (2, 297) | .007 |
| Mean | 61.53 | 58.19 | 61.85 | | | |
| SD | 8.75 | 9.27 | 8.95 | | | |
| Min | 44 | 36 | 41 | | | |
| Max | 83 | 77 | 85 | | | |
| Possible range | 0-108 | | | | | |
| **1. Diet** | | | | 6.070 | (2, 297) | .009 |
| Mean | 28.20 | 25.54 | 28.84 | | | |
| SD | 4.31 | 4.48 | 4.09 | | | |
| Min | 18 | 14 | 17 | | | |
| Max | 36 | 36 | 39 | | | |
| Possible range | 0-42 | | | | | |
| **2. Exercise**[#] | | | | | | NS |
| Mean | 2.35 | 2.28 | 2.51 | | | |
| SD | 1.10 | 1.54 | 1.63 | | | |
| Min | 0 | 0 | 0 | | | |
| Max | 6 | 6 | 6 | | | |
| Possible range | 0-6 | | | | | |
| **3. Self-monitoring** | | | | 5.206 | (2, 297) | NS |
| Mean | 4.00 | 4.24 | 3.52 | | | |
| SD | 2.44 | 2.31 | 2.76 | | | |
| Min | 0 | 0 | 0 | | | |
| Max | 10 | 9 | 12 | | | |
| Possible range | 0-12 | | | | | |

**Table 2** Comparison of Diabetes Self-Care Abilities among Participants Receiving Care via Three Primary Care Practice Models (Continued)

| Dimensions of DSCA | NP - MD$^{f}$ n=100 | NP - MD$^{p}$ n=100 | NP n=100 | F | $df_1$, $df_2$ | *p-value* |
|---|---|---|---|---|---|---|
| **4. Follow up** | | | | 4.537 | (2, 297) | .038 |
| Mean | 9.95 | 7.42 | 11.20 | | | |
| SD | 1.95 | 1.90 | 3.48 | | | |
| Min | 2 | 1 | 4 | | | |
| Max | 12 | 12 | 20 | | | |
| Possible range | 0-12 | | | | | |
| **5. Foot care**# | | | | | | NS |
| Mean | 9.20 | 10.70 | 9.55 | | | |
| SD | 3.48 | 3.19 | 3.60 | | | |
| Min | 4 | 3 | 2 | | | |
| Max | 20 | 18 | 21 | | | |
| Possible range | 0-27 | | | | | |
| **6. Medication Adherence** | | | | 4.320 | (2, 297) | NS |
| Mean | 7.83 | 8.01 | 7.13 | | | |
| SD | 1.23 | 1.37 | 1.134 | | | |
| Min | 5 | 3 | 3 | | | |
| Max | 9 | 9 | 9 | | | |
| Possible range | 0-9 | | | | | |

**Note:** DSCA = Diabetes self-care ability; NP = Nurse practitioner model; NP-MDsquare = Nurse practitioner-Physician full-time model; NP-MDsquare = Nurse practitioner-Physician part-time model; #Kruskal -Wallis test; NS = Non-significant (p-value> .05)

***Patient's Satisfaction with Care* (PSC):** As shown in **Table 3**, participants receiving care from all three models were highly satisfied with their care. However, those receiving care via the NP model had the highest mean score on the PSC and the two sub-dimensions, humanizationand accessibility to care services. However, participants receiving care viathe NP model had the lowest mean score on the sub-dimension of professional competence. MANOVA showed significant differences, among those receiving care via the three models, in the mean scores of the PSC and the sub-dimension of accessibility. The Tukey's HSD test showed there was no significant difference in the mean satisfaction with care score between those receiving care via the NP and NP-MD$^{p}$ models ($p$> .05), while those receiving care from both the NP and NP-MD$^{p}$ models had significantly higher mean satisfaction scores than those receiving care via the NP-MD$^{f}$ model ($p$< .05). For the sub-dimension, satisfaction with accessibility, those receiving care via the NP and NP-MD$^{p}$ models had significantly higher mean scores than those receiving care via NP-MD$^{f}$ model ($p$< .001). No significant difference in satisfaction with accessibility was found between participants receiving care via the NP and NP-MD$^{p}$ models ($p$> .05).

**Table 3** Comparison of Satisfaction with Careamong Participants Receiving Care via Three Primary Care Practice Models

| Dimensions of PSC | NP – MD$^f$ n=100 | NP – MD$^p$ n=100 | NP n=100 | F | $df_1$, $df_2$ | *p-value* |
|---|---|---|---|---|---|---|
| **Total PSC** | | | | 19.411 | (2, 297) | < .001 |
| Mean | 61.32 | 64.12 | 65.69 | | | |
| SD | 5.077 | 4.557 | 6.108 | | | |
| Min | 45 | 53 | 50 | | | |
| Max | 75 | 74 | 75 | | | |
| Possible range | 15-75 | | | | | |
| **1. Accessibility to care** | | | | 11.865 | (2, 297) | .018 |
| Mean | 21.18 | 25.20 | 26.29 | | | |
| SD | 4.68 | 3.87 | 4.64 | | | |
| Min | 17 | 18 | 20 | | | |
| Max | 29 | 30 | 30 | | | |
| Possible range | 6-30 | | | | | |
| **2. Provider's competency** | | | | 2.032 | (2, 297) | .524 |
| Mean | 8.56 | 8.42 | 7.65 | | | |
| SD | 2.38 | 2.95 | 1.89 | | | |
| Min | 8 | 8 | 7 | | | |
| Max | 10 | 10 | 10 | | | |
| Possible range | 2-10 | | | | | |
| **3. Provider's humanization** | | | | 1.598 | (2, 297) | .642 |
| Mean | 31.58 | 30.50 | 31.65 | | | |
| SD | 5.17 | 4.62 | 5.36 | | | |
| Min | 26 | 28 | 28 | | | |
| Max | 34 | 34 | 35 | | | |
| Possible range | 7-35 | | | | | |

Note: PSC = Patients' satisfaction with care; NP = Nurse practitioner model; NP-MDf = Nurse practitioner-Physician full-time model;NP-MDp = Nurse practitioner-Physician part-time model; NS = Non-significant (p-value> .05)

***Diabetes Quality of Life* (DQOL):** As shown in **Table 4**, participant sreceiving care via the three modelshad a moderate level of total DQOL, with those receiving care via theNP model having the highest mean scores for total DQOL and both sub-dimensions, life satisfaction and life impact. MANOVA showed a significance difference, among those receiving care via the three models, in the mean scores for total DQOL and both sub-dimensions, life satisfaction and life impact. Participants receiving care from the NP and NP-MD$^f$ models had significantly higher mean scores on the sub-dimension, life satisfaction, than those receiving care from the NP-MD$^p$ model ($p$< .05). In addition, those receiving care from the NP and NP-MD$^f$ models had significantly higher mean scores on the sub-dimension, life impact, than those receiving care from the NP-MD$^p$ model ($p$< .001and $p$< .05 respectively). Significant differences were noted in the life satisfaction and life impact scores between the NP and NP-MD$^f$ models ($p$> .05).

**Table 4** Comparison of Diabetes Quality of Lifeamong Participants Receiving Care via Three Primary Care Practice Models

| Dimensions of DQOL | NP – MD[f] n=100 | NP – MD[p] n=100 | NP n=100 | F | $df_1$, $df_2$ | *p-value* |
|---|---|---|---|---|---|---|
| **Total DQOL** | | | | 11.584 | (2, 297) | < .001 |
| Mean | 72.79 | 69.42 | 73.43 | | | |
| SD | 7.19 | 5.98 | 6.83 | | | |
| Min | 59 | 54 | 60 | | | |
| Max | 86 | 85 | 88 | | | |
| Possible range | 20-100 | | | | | |
| **1. Life satisfaction** | | | | 9.693 | (2, 297) | .032 |
| Mean | 71.56 | 68.89 | 72.25 | | | |
| SD | 5.308 | 4.23 | 5.671 | | | |
| Min | 59 | 56 | 57 | | | |
| Max | 74 | 74 | 75 | | | |
| Possible range | 20-100 | | | | | |
| **2. Life impact** | | | | 12.840 | (2, 297) | .008 |
| Mean | 75.02 | 70.95 | 75.61 | | | |
| SD | 5.687 | 5.236 | 5.892 | | | |
| Min | 64 | 61 | 66 | | | |
| Max | 82 | 80 | 83 | | | |
| Possible range | 20-100 | | | | | |

**Note:** DQOL = Diabetes quality of life; NP = Nurse practitioner model; NP-MD square = Nurse practitioner-Physicianfull-time model; NP-MD square = Nurse practitioner-Physician part-time model; NS = Non-significant (p-value> .05)

## Discussion

***Fasting Capillary Blood Glucose* (FCBG*):*** Approximately one third of the participants had good glycemic control. This is consistent with the findings of a previous study,[25] wherein 26.3% of patients with type-2 diabetes who attended a diabetes clinic at a Thai university hospital had a HbA1C of less than 7%. About half of the participants, in this study,who were receiving care via all three models had fair glycemic control (FBG = 130-149.99 mg/dl), while about 20% had poor glycemic control. The FCBG values, in this study, tended to be higher among the elderly participants (M = 60.7 years; SD = 10.07). This might have been due to the healthcare providers being particularly concerned about hypoglycemia, which is a major risk of tight glucose control, among the elderly. Thus, the clinicians' approaches to what constituted acceptable glucose control was individualized.[26] However, the goal for blood glucose control, for the elderly, probably should have been the same as for younger patients; namely, near-normal FCBG levels (< 126 mg/dl) without hypoglycemia.[26] Among the elderly, whose care is complicated by chronic medical illness, frailty, isolation, and/or a shortened life expectancy, the reduction of hyperglycemia signs and

symptoms,rather than accomplishment of a normal glucose level, is a preferable goal for clinical management.[27] Maintenance of postprandial glucose level < 200-250 mg/dl generally is adequate for achieving these goals, and, in most cases, a FCBG level of < 145 mg/dl is attainable with few hypoglycemic episodes.[27, 28]

No significant differences were found in the mean values of the FCBG of those receiving care via the three primary care models. This finding could be explained by the fact the providers, from all three primary care models, delivered diabetes care using the same clinical practice guidelines as those recommended by the NHSO. Furthermore, this finding supports the idea that the different models of primary care practice achieved equivalent outcomes regarding the FCBG values. In addition, non-significant differences of co-morbidities and types of regimens among those receiving care from the three models were seen. One prior study illustrated that co-morbidity does not appear to limit achievement of good glycemic control; [29] However, multivariate linear regression showed that receiving different pharmacological therapy was a significant contributor to HbA1c levels. The findings of the current study were consistent with those of a previous study,[30] wherein no difference in the mean values of the HbA1c between the NP providers and physician providers were found.

***Diabetes Self-Care Ability* (DSCA):** Most of the participants receiving care via the three models manifested a moderate level of DSCA, which might be explained by the fact that most of them were older adults ($\bar{x}$ = 60.7) with an elementary school education (88%). In addition, a prior study found older age to be associated with lower literacy and lower self-management behaviors.[31]

The findings, of the present study, indicated the mean DSCA scores, between those receiving care from the NP and NP-MD$^f$ models, to not be significantly different ($p$> .05). However, the mean scores for total DSCA and the two sub-dimensions, diet and follow-up, among the participants receiving care via the NP and NP-MD$^f$ models,were significantly higher than the mean scores of those receiving care via the NP-MD$^p$ model ($p$< .05). This may be because the physicians, in the PCUsusing the NP-MD$^p$ model, routinely worked only two days a week. As a result, the NP's role was used to substitute the physicians' role. Thus, the NP's were more likely to pay attention to delivery of medical care service than to promoting self-care education. Furthermore, the primary care services delivered via the NP-MD$^p$ model typically were scheduled to be open to all patients, including those with diabetes. Thus, the care services were not specifically focused onor allotted sufficient time for dealing exclusively with patients being seen in the diabetes clinic. As a previous study indicated, self-care education and self-management programs need sufficient time for consulting visits that have good relationships among the healthcare providers and clients.[32]

Another reason for the significantly lower mean score on the sub-dimension, follow-up,may have been due to the fact that five of the participants receiving care via the NP-MD$^p$ model had difficulty with follow-up visits because no caregivers accompanied them to the PCU. In addition, some of them had to travel to another country during the year, which prevented them from keeping their follow-up visits.

Interestingly, the mean scores on the sub-dimension, diet, among those receiving care via the three models, were not high. The nurse practitioners, community health workers, and physicians, in all three models, were more likely to perform short-term, traditional, didactic teaching rather than focusing on empowering participants regarding diabetes self-care. Instead, the healthcare providers focused more on individual needs. This finding was consistent with prior research that found knowledge is not enough to improve self-care or self-management among individuals with diabetes.[33] Enhancing values of experience and understanding about diabetes can lead to a person's appreciation about diabetes self-care.[32]

Thus, self-care education and self-management programs should be carried out and focused more on empowering patients.[34, 35]

***Patients' Satisfaction with Care* (PSC):** Most of the participants receiving care via all three models had a high level of PSC. It is possible that this finding was the result of the providers and participants having good relationships. Most of the care providers had worked in their specific primary care setting for many years. Bryant and Graham [33] noted that the healthcare provider's ability to display empathy and concern contributes positively to enhancing patient satisfaction. In addition, primary care settings within dwelling areas, that support patients' access to services and saves time/traveling costs, might lead to a high satisfaction level. However, one must remain aware that social desirability bias is a tendency of respondents to reply in a manner that will be viewed favorably by others. This generally is in the form of over-reporting high satisfaction.

The results of this study indicated no significant difference, among the participants receiving care via the NP and NP-MD$^{p}$ models, in the mean scores for total PSC($p$> .05). Those receiving care via both the NP and NP-MD$^{p}$ models had significantly higher mean scores on total satisfaction and the sub-dimension, accessibility,than those receiving care via the NP-MD$^{f}$ model ($p$< .05 and < .001, respectively). This might be because many of the participants receiving care via the NP-MD$^{f}$ model complained they had to wait a long time (35-50 minutes) to see a physician. Two items in the PSCQ that focused on these data were: "Health providers give their hand as soon as you need it" and "I can access care service easily and conveniently." Since, those receiving care via the NP-MD$^{f}$ model did not score either one of these items very high, this may help explain their significantly lower mean scores on both the total PSC and the sub-dimension, accessibility. In addition, in the NP model, the diabetes clinic was routinely operated once a month and almost all of the patients with diabetes could attend the clinic. Thus, they could meet as a group and share their experiences, problems, and concerns about having diabetes. The friendly atmosphere provided an opportunity for interpersonal interactions among themand with the healthcare providers. Prior studies have supported the idea of groups of people with diabetes meeting together to share experiences and support each other. Given the right environment, this could improve their interpersonal relationships and increase their satisfaction with the care they received. [34,35]

***Diabetes Quality of Life* (DQOL):** Overall, the participants receiving care via all three models manifested a moderate level of DQOL. This could be explained by the fact that factors, such as gender, income, and education, might be associated with one's DQOL. Prior studies have shown variability in effects of type-2 diabetes on one's DQOL. For instance, Gafvels [35] found that diabetes among women appears to make a greater impact on their DQOL and generate more worries about complications for them than men. Issa and Baiyewu [37]also found that lower income, less education, no employment, and physical complications adversely affect one's DQOL. In the present study, most of the subjects were female and primary school graduates (87.6%). About two thirds (69.0%) of them had an income of less than 5,000 baht per month, with more than half having at least one co-morbidity (i.e., hypertension and dyslipidemia). These factors might have contributed to theparticipants havingonly a moderate level of DQOL.

No significance differences were found in the mean scores, among the participants receiving care via the NP and NP-MD$^{f}$ models ($p$>.05), regarding their total DQOL. On the other hand, the mean scores on total DQOL and the sub-dimensions of life satisfaction and life impact, among those receiving care via these two models,were significantly higher than those receiving care via the NP-MD$^{p}$ model ($p$< .05).

According to the demographic data, five participants with diabetic foot ulcers received care via the NP-MD$^{p}$ model, whereas only one person witha diabetic foot ulcer was seen among those receiving care via the NP and NP-MD$^{f}$ models. Prior studies have revealed that chronic diabetic foot ulcers and amputations to be associated with a lower quality of life and a high level of depression.[38, 39]

In conclusion, the diabetic care outcomes of the participants receiving care via the NP model were comparable to the outcomes of those receiving care from the NP-MD$^{f}$ and NP-MD$^{p}$models. Thus, NPs with four months of advanced practice training, who have had at least two years of clinical experience as RNs, were able to provide diabetic care at the primary care level with the same degree of quality as the providers offering healthcare via the other two models(NPs and full/part time MDs working together).

## Limitations and Recommendations for Future Research

When applying the study's findings, limitations need to be taken into consideration. First, using FCBG measurements through a glucometer, in this study, most likely produced higher glucose levels than actually existed. Thus, future studies need to consider use of HbA1c for assessing patients' blood glucose levels. Secondly, participants were recruited from only six primary care settings, in one province, in Thailand. As a result, generalizability of the findings is limited. Future studies need to consider the use of a larger number of primary care settings that are located throughout the country. Finally, one has to assume the participants were honest in their responses regarding items on the questionnaires. It may prove beneficial, in future studies, to use additional means of data gathering (i.e., interviews with participants, family members, and healthcare providers).

## Future Implications for Practice

Even though the NPs seemed to be as good as the MDs in providing diabetes care, continuing education is necessary to improve diabetic outcomes, especially regarding glycemic control. Knowledge and skills in empowering patients, families, and communities to become involved in diabetes care are needed. Also, self-management and case management should be focused on continuing education. In the future, nurses that work independently in a primary care setting should be prepared as advanced practice nurses at a master's or doctoral level. However, in light of the physician shortages in many developing countries, a four-month short course for experienced nurses, with good clinical practice guidelines, can improve the accessibility and quality of healthcare services to people in remote and underserved areas.

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# เปรียบเทียบผลลัพธ์ของผู้ป่วยเบาหวานที่ได้รับการดูแลในสถานบริการสุขภาพปฐมภูมิ 3 รูปแบบ

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**บทคัดย่อ**: การศึกษานี้มีวัตถุประสงค์เพื่อเปรียบเทียบผลลัพธ์ของการดูแลผู้ป่วยเบาหวานระหว่างกลุ่มที่ได้รับการรักษาที่สถานบริการปฐมภูมิใน 3 รูปแบบ คือ รูปแบบการมีพยาบาลเวชปฏิบัติ และแพทย์เต็มเวลา (NP-MD$^{f}$), รูปแบบการมีพยาบาลเวชปฏิบัติเต็มเวลา และแพทย์บางเวลา(NP-MD$^{p}$) และรูปแบบการมีพยาบาลเวชปฏิบัติเต็มเวลาโดยไม่มีแพทย์ (NP model)โดยวัดผลลัพธ์การดูแลผู้ป่วยเบาหวานประกอบด้วยการควบคุมระดับน้ำตาลในเลือด ความสามารถในการดูแลตนเอง ความพึงพอใจในบริการ และคุณภาพชีวิตระหว่างผู้ป่วยเบาหวาน กลุ่มตัวอย่าง คือ ผู้ป่วยเบาหวานทั้งหมด จำนวน 300 คน แบ่งเป็นรูปแบบของสถานบริการปฐมภูมิ อย่างละ 100 คน ในจังหวัดหนึ่งในภาคกลางของประเทศไทย คัดเลือกกลุ่มตัวอย่างโดยใช้การเลือกแบบสะดวก เก็บรวบรวมข้อมูลโดยใช้แบบประเมินความสามารถในการดูแลตนเอง แบบประเมินความพึงพอใจ แบบประเมินคุณภาพชีวิตในผู้ป่วยเบาหวาน วิเคราะห์ข้อมูลด้วยสถิติบรรยาย และMANOVA

ผลการศึกษาพบว่า 1) ระดับน้ำตาลในเลือดขณะอดอาหารของผู้ป่วยเบาหวานในทั้ง 3 รูปแบบไม่แตกต่างกัน ($p$> .05); 2) คะแนนเฉลี่ยความสามารถในการดูแลตนเอง และคุณภาพชีวิตของผู้ป่วยเบาหวานในรูปแบบNP-MD$^{f}$ และ NP สูงกว่ารูปแบบ NP-MD$^{p}$ อย่างมีนัยสำคัญทางสถิติ ($p$< .05); 3) คะแนนเฉลี่ยความพึงพอใจในรูปแบบ NP-MD$^{p}$ และNP สูงกว่ารูปแบบ NP-MD$^{f}$ อย่างมีนัยสำคัญทางสถิติ ($p$< .05)

ผลการศึกษาชี้ให้เห็นว่าพยาบาลเวชปฏิบัติหลักสูตรระยะสั้น 4 เดือนสามารถให้การดูแลผู้ป่วยเบาหวานในสถานบริการระดับปฐมภูมิได้คุณภาพเทียบเท่ากับการดูแลโดยแพทย์ และรูปแบบ NP มีแนวโน้มที่จะเกิดผลลัพธ์ในเชิงจิตสังคมและพฤติกรรม (ความสามรถในการดูแลตนเอง ความพึงพอใจ และคุณภาพชีวิตของผู้ป่วย) มากกว่ารูปแบบอื่น

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**คำสำคัญ:** ผลลัพธ์ผู้ที่เป็นโรคเบาหวานรูปแบบการดูแลสุขภาพระดับปฐมภูมิและพยาบาลเวชปฏิบัติ

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