

A Nurse-Led Inpatient Diabetes Self-Management Education and Support Program to Improve Patient Knowledge and Treatment Adherence

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ABSTRACT

Purpose: Diabetes mellitus (DM) is a growing problem in the United States and worldwide. Diabetes possesses a significant burden on the healthcare costs. An evidence-based, practical, and economically feasible strategy to tackle the growing burden of DM is imminent. Diabetes self-management education and support (DSMES) is the backbone to improve the care in DM. A research study called a nurse-led inpatient DSMES was designed and implemented in a community hospital on the west coast to improve patient knowledge of DM and medication adherence with DM. **Methods:** A descriptive, pretest-posttest study was employed to evaluate the effects of a DSMES program on patient knowledge of DM and patient medication adherence in an inpatient setting on the West coast. Convenience sampling was utilized, and the sample included 10 participants. Paired t-test was used to compare the group means before and after the provision of DSMES to the same sample. **Results:** The study revealed a statistically significant improvement ($p = .026$) in the participants' knowledge of DM after the provision of DSMES while no changes (although not statistically significant, $p = 1.00$), in the participants' medication adherence. **Conclusions:** Provision of DSMES by nurses can improve the outcomes of patients with DM in inpatient settings. **Recommendations:** Implementation of a nurse-led DSMES project has the potential to improve patient knowledge and diabetes self-management skills, which can, in turn, improve treatment adherence and potentially prevent frequent hospitalizations in patients with DM. Further large-scale studies are needed to generate further evidence to support the provision of DSMES by nurses.

Key Words: diabetes self-management education and support, patient knowledge, medication adherence.

INTRODUCTION

Diabetes mellitus is a growing problem in the United States and worldwide. According to the Centers for Disease Control and Prevention (CDC) (2017), more than 12% of the adults in the United States suffer from DM. Around 3% of the patients with DM are undiagnosed (CDC, 2017). In the U.S. DM is the seventh leading cause of death (Kochanek, Murphy, Xu, & Tejada-Vera, 2016). There are 1.5 million newly diagnosed cases of DM in the U.S. every year

(American Diabetes Association [ADA], 2017). It is estimated that by 2060, the number of adults diagnosed with DM will be tripled in the U. S. (Lin et al., 2018).

Diabetes has emerged as a major chronic illness that is putting significant strain on the current healthcare. Individuals with undiagnosed or diagnosed DM, and those with pre-diabetes are more prone to hospitalizations when compared to those without DM (Schneider et al., 2016). In 2010, DM contributed towards 34.67

million hospital days in the United States and 622,000 hospitalizations had DM as the primary diagnosis upon discharge (McEwen & Herman, 2016). According to McCoy et al. (2017), acute diabetes-related complications (ADC) is the second most common reason for hospitalizations in patients with DM. Evidence suggests that prior ADC history strongly predicts hospital readmissions for ADC and non-ADC reasons (McCoy et al., 2017).

Self-management implies a core component in the care of DM and appropriate self-management can positively impact the health outcomes of patients with DM (Albisser, Harris, Albisser, & Sperlich, 2001). Diabetes self-management education (DSME) implies the method of facilitating the ability, knowledge, and skills imminent for self-care in DM. On the other hand, diabetes self-management support (DSMS) involves the support needed for initiating and maintaining coping behaviors and skills to self-manage on a continuous basis (Powers et al., 2017). The DSME and DSMS together referred to as DSMES involves a continuous process of improving the skill, knowledge, and ability needed for self-care of diabetes and prediabetes along with activities that aid a person in initiating and sustaining the behaviors required to manage one's condition on a continuum outside of formal training in self-management (Beck et al., 2017). Patient education by healthcare providers had shown to increase medication adherence in patients with DM (Larkin, Hoffman, Stevens, Douglas, & Bloomgarden, 2015). Inpatient diabetes education (IDE) has shown to improve glycemic control in patients who were novel to insulin after one year of discharge from hospitals (Wexler et al., 2012).

PURPOSE

The purpose of this research study was to utilize an evidence-based nurse-led DSMES program in a community hospital on the west coast to improve patient knowledge on DM and improve patient adherence to treatment strategies. According to Worrall, Levin, and Arsenault (2009), evidence-based practice (EBP) projects have the capability of improving practice beyond a local area or a given facility. In the given hospital, it has been noted that a large proportion of patients get hospitalized due to DM and its complications. A considerable proportion of the admissions for DM and its

complications were related to poor knowledge of DM and decreased medication adherence. Inadequate diabetes knowledge and poor skills in self-management can be linked to the emergency department (ED) visits and hospitalizations related to uncontrolled DM (Magee, Khan, Desale, & Nassar, 2014). Evidence suggests a shorter length of stay and improved outcomes post-discharge after the provision of inpatient diabetes education (Nettles, 2005). Evidence suggests that DSMES can reduce hospital readmissions and hospital admissions in patients with DM (Duncan et al., 2011; Healy, Black, Harris, Lorenz, & Dungan, 2013).

Many guidelines for EBP uses the acronym PICOT for forming clinical questions. The PICOT implies the population of interest (P), the intervention planned (I), the comparison (C), the outcome (O), and the time (T) (Polit & Beck, 2017). After a review of the literature available on diabetes education, a clinical question was identified for the project using PICOT. In patients with DM (P) who are admitted to a local community hospital on the West coast during a six-month period (T), what are the effects of a nurse-led DSMES project (I) in improving (C) their knowledge on DM and their compliance with the treatment strategies (O)?

METHODS

A single group quantitative, descriptive, pretest-posttest design was used to implement the project, which involved the use of a nurse-led DSMES program to improve patient knowledge of DM and improve medication adherence. The design did not include any randomization as the project involved only a single group. The sampling method employed was convenience sampling. The primary outcomes of the project measured were patient knowledge of DM and medication adherence both before and after the provision of the DSMES program.

Subjects

The subjects involved patients with DM who were admitted to a community hospital on the West coast. The project involved inpatient adults between 18 years to 65 years with a diagnosis of DM type 1 or type 2. The subjects could read, speak, write, and understand English. Anyone with cognitive or sensory impairments and critical illnesses were excluded. Pregnant and

nursing women or those with gestational diabetes were also excluded. The potential participants were identified from the daily list of inpatients with DM who were admitted to the facility where the project was conducted. The majority of the participants came from the patient population directly under the care of the principal investigator. Nurses in the respective units who were involved in the care of patients with DM also helped to identify participants who could potentially benefit from the project. A flyer on the project was given to the potential participants by the principal investigator and unit nurses.

Approval for the project was obtained from Maryville University Institutional Review Board (IRB). The hospital where the study was conducted has no IRB. The participants were provided with informed consents of the project including the purpose, risks, benefits, protection of privacy, and voluntary involvement or withdrawal. The participants were assured that their involvement is completely voluntary and their participation in the project will not affect the care or treatments during the hospitalization. The participants were informed that there would not be any penalty for withdrawal from the project. The first session started with the participants signing the informed consent followed by an assessment of the participants' knowledge on DM with the Revised Diabetes Knowledge Test (DKT2) and medication adherence with the Morisky, Green, and Levine Adherence Scale also referred to as the Medication Adherence Questionnaire (MAQ). Permission was obtained to use the DKT2 and MAQ for the project from the respective developers.

Instruments

The DKT2 involves a 23-item questionnaire, 14 of which assess general knowledge of DM and the rest of the questions assess the patient knowledge of insulin (Appendix A). Therefore, the DKT2 may involve only 14 questions if the patient being assessed is not using insulin and can involve 23 questions if the patient with DM is also using insulin. The DKT2 is a reliable and valid tool for assessing the general knowledge on DM in patients with type 1 and type 2 DM. The structure and core content of the DKT2 is similar to that of DKT, thereby robustness and generalizability of DKT2 are almost identical to that of DKT (Fitzgerald et al., 2016).

The MAQ is a four-item questionnaire with a yes or no format. If the answer to a question is yes, then it corresponds to zero points, and if the answer to a question is no, then it corresponds to one point (Appendix B). The score for MAQ ranges from zero to four, zero being the highest (most adherent) and four being the lowest (least adherent). The MAQ has good predictive validity (Morisky, Green, & Levine, 1986). According to Culig and Leppee (2014), the MAQ is closest to the gold-standard among self-reported scales of medication adherence although the reliability is better with some other scales. A systematic review by Perez-Escamilla, Franco-Trigo, Moullin, Martinez-Martinez, and Garcia-Corpas (2015), showed that the MAQ showed similar indicators of validity and reliability as the other commonly used self-reported scales of medication adherence.

Reliability and validity of the instruments.

Since the instruments used in this project are not new, the calculation of content validity index was not used. On the other hand, when referring to the content validity of an instrument one can refer to literature on expert reviews on the instrument, specifically published reports on the testing and development of the instrument (Tappen, 2016). Therefore, the content validity of the instruments used in the project was confirmed using literature available on testing and development of the instruments. The study by Fitzgerald et al. (2016) showed that the DKT2 is a valid tool for assessing the general knowledge on DM in patients with type 1 and type 2 DM. The study by Morsiky, Green, and Levine (1986) showed that MAQ is a valid tool in measuring self-reported medication adherence.

Reliability reflects the consistency and accuracy of the information obtained from a study (Polit & Beck, 2017). Three aspects are considered while determining the reliability of instruments, which are stability, equivalence, and homogeneity (Mateo & Kirchhoff, 1999). Stability and equivalence of DKT2 and MAQ were not assessed in this study. The homogeneity of an instrument is often determined by calculation of Cronbach's alpha coefficient. Cronbach's alpha is used to determine that the individual items in an instrument measure the same concept. A Cronbach's alpha of 0.70 or more is usually considered acceptable (Glod, 2014). The original study by Morisky et al. (1986) showed a Cronbach alpha for MAQ of 0.61. On the other

hand, Cronbach alpha for DKT2 in the original study was 0.77 for the general test and 0.84 for the insulin use subscale (Fitzgerald et al., 2016).

Procedure

The initial DKT2 and MAQ formed the pretest. After obtaining the baseline data, the subjects participated in a one-to-one non-structured education that included the delivery of DSMES using a brochure on American Association of Diabetic Educators (AADE) seven Self-Care Behaviors™ designed by the author. The principal investigator delivered the DSMES in the respective participants' rooms. The AADE7 Self-Care Behaviors™ are healthy eating, active lifestyle, monitoring blood sugars, medication adherence, problem-solving, risk reduction, and healthy coping (AADE, 2017). Posttest surveys on DKT2 and MAQ were obtained by the principal investigator from the same participants 24 hours after the first session.

Survey research was employed in data collection. A survey is devised to extract data on the distribution, prevalence, and interrelations of phenomena in a given population. Surveys are dependent on participants' self-report on a number of questions designed by the investigator. Survey research includes personal interviews, telephone interviews, questionnaires, etc. While interviews are administered by the investigators, questionnaires are often self-administered (Polit & Beck, 2017). Therefore, the two self-administered questionnaires (SAQ) in the form of DKT2 and MAQ were used in the data collection. Both the questionnaires used in the project have fixed-alternatives also referred to as closed-ended questions.

RESULTS

Data analysis was done using the Statistical Package for the Social Sciences (SPSS). The independent variable is diabetes education, and this is a categorical variable with two levels (before and after the provision of DSMES). The dependent variables are patient knowledge of DM and medication adherence. Medication adherence measured with MAQ and patient knowledge of DM measured with DKT2 are scalar variables. The effects of diabetes education utilizing DSMES on MAQ and DKT2 was done using the related sample *t*-test. When comparing the group means of the same group before and after the provision of treatment, then

the paired *t*-test or the related sample *t*-test can be employed (Kim & Mallory, 2017).

Statistical analysis was done by obtaining descriptive statistics. The sample size was 10, and the mean age of the participants was 46 years with a standard deviation of 9.37. More than 50% of the participants in the project were Hispanics, followed by Caucasians, and Asians (Table 1). Inferential statistics were done with measurement of the participant knowledge on DM with mean DKT2 before the provision of DSMES (DKT2 pretest) compared to the mean participant score on DKT2 after the provision of DSMES (DKT2 posttest). The mean DKT2 pretest was 73.04 with a standard error of 5.61, and the mean DKT2 posttest was 79.56 with a standard error of 5.27. The participants' medication adherence measured with mean MAQ was the same (62.50) before and after the provision of DSMES indicating no effects of DSMES (Table 2).

The calculated *t*-statistic for DKT2 was -2.67. The *p*-value was .026, which is less than .05, the preset alpha. Therefore, the null hypothesis can be rejected. The mean DKT2 ($M=79.56$, $SE=5.27$) was significantly higher after DSMES provision as compared to the mean DKT2 before DSMES provision ($M=73.04$, $SE=5.60$), $t(9) = -2.67$, $p=.026$. The *t*-statistic for MAQ was .00. The *p*-value was 1.00, which is greater than .05, the preset alpha. Hence the null hypothesis cannot be rejected. The mean MAQ ($M=62.50$, $SE=13.04$) was not significantly higher after DSMES provision as compared to the mean MAQ before DSMES provision ($M=62.50$, $SE=12.50$), $t(9) = .00$, $p=1.00$ (Table 3).

CONCLUSIONS

The research project had confirmed the effectiveness of DSMES delivered by nurses to improve the patient knowledge of DM. However, the medication adherence did not change as a result of the intervention. The project was done in a 24-hour period, which may not be enough for the participants to have a change in their medication adherence behavior. This research project possesses the characteristics to be replicated. Data retrieved with quantitative methods are believed to produce more accurate and objective findings because of the use of collection methods that are standardized, and therefore, quantitative studies possess the properties to be replicated (National Science

Foundation, n. d.). The project with the use of standardized measures such as DKT2 and MAQ can be replicated by other researchers.

The DSMES is a relatively cheap tool that can be used in healthcare organizations where DM patients seek medical attention. Training nurses in the provision of DSMES is relatively easier. Delivery of DSMES is not complicated as this requires no use of any sophisticated teaching tools or gadgets, and DSMES provision requires relatively less time. Provision of DSMES can be easily incorporated into the routine care provision of nurses to DM patients. Provision of DSMES by nurses for DM patients should become the standard of care.

One of the limitations of this research study was the length of time that was available to complete the study. The relatively less time available for the study resulted in recruiting a lower number of participants within the time frame. A small sample size was a challenge to the credibility of the results of the study. Since this is an EBP project, no power analysis was used to obtain the minimum number of participants needed to ensure generalization of the results of the project. Use of convenience sampling was another limitation of the project. Convenience samples often have less generalizability when compared to probability sampling (Jager, Putnick, & Bornstein, 2017). Another limitation of this project is that the participants included only those who can read, write, speak, and understand English.

To conclude, DM is a growing epidemic in the U.S. and worldwide. Diabetes is associated with increased hospitalizations and increased length of hospital stay (Lee et al., 2017). Inadequate knowledge and poor self-management skills have been linked to hospitalizations from uncontrolled DM (Magee et al., 2014). The DSMES is the backbone to improve the care in DM (Powers et al., 2017). Use of DSMES has been associated with improvement in different clinical aspects of diabetes management of individuals. Evidence suggests significant improvement in glycemic control in DM with the use of DSMES (Chrvala, Sherr, & Lipman, 2016; Cooke et al., 2013). Improved quality of life from DSMES has also been reported (Cooke et al., 2013). Use of DSMES has also been associated with improved self-care behaviors (Tang, Funnell, & Oh, 2012) and decreased distress related to DM (Fisher et al., 2013).

The role of nurses including advanced practice nurses (APNs) in the provision of DSMES remains vague. There is an imminent need for an evidence-based DSMES program to be used as the standard of care in patients with DM. Implementation of a nurse-led DSMES project has the potential to improve patient knowledge and diabetes self-management skills, which can improve treatment adherence and potentially prevent frequent hospitalizations in patients with DM. Provision of DSMES by nurses should be considered to be utilized as the standard of care of patients with DM not only in inpatient settings but also in other clinical settings where the provision of DSMES is amenable.

RECOMMENDATIONS

Patient education is a vital role for all nurses (Fowler, 2012). Provision of DSMES by nurses has the potential to improve outcomes of patients with DM. Regrettably, a majority of individuals with DM or pre-diabetes do not receive appropriate DSMES services (Thalheimer, 2018). A better comprehension of evidence-based practices such as DSMES by nurses involved in the care of hospitalized patients with DM can improve the care outcomes (Yacoub et al., 2015).

There are four critical times when assessment and delivery of DSMES are very essential. The four critical times include at diagnosis, during the transition of care, when there are new complicating circumstances that influence self-management, and annually (Powers et al., 2017). Among the four critical times, inpatient hospitalizations may result in two critical times that require assessment and delivery of DSMES. Two critical times that can occur from inpatient hospitalizations include the transition of care and presence of complicating factors that can affect self-management. Therefore, inpatient hospitalizations provide an important opportunity for the provision of DSMES. Advanced practice nurses and nurses who deliver care to patients with DM in inpatient settings are privileged to have better opportunities to provide DSMES at critical times during inpatient hospitalizations.

This project has the potential to be utilized in other facilities including outpatient facilities for the provision of DSMES. Implementation of this project is inexpensive, and the nurses including

APNs do not require any special training to employ this project. No special settings such as classrooms or expensive platforms are necessary to implement this project. Therefore, facilities with limited funding for education like the one where the project was conducted can introduce DSMES to be used by nurses while taking care of patients with DM.

Further large-scale studies in different clinical settings to evaluate the effects of DSMES are required to strengthen the evidence of the effects of DSMES on the different aspects of DSMES. Clinical studies using DSMES in different languages are also needed to find the effects of DSMES on different ethnicities. Studies to evaluate the effectiveness of DSMES provision by nurses versus healthcare providers can compare the effectiveness of DSMES provision by different personnel who are directly involved in the care of the patients with DM.

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Table 1: Participant Demographics

| Ethnicity | Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------|-----------|---------|---------------|--------------------|
| Caucasian | 3 | 30.0 | 30.0 | 30.0 |
| Hispanic | 6 | 60.0 | 60.0 | 90.0 |
| Asian | 1 | 10.0 | 10.0 | 10.0 |
| Total | 10 | 100.0 | 100.0 | |

Table 2: Paired Samples Statistics

| | | Mean | N | Std. Deviation | Std. Error Mean |
|--------|---------------|-------|----|----------------|-----------------|
| Pair 1 | DKT2 Pretest | 73.04 | 10 | 17.73 | 5.61 |
| | DKT2 Posttest | 79.56 | 10 | 16.66 | 5.27 |
| Pair 2 | MAQ Pretest | 62.50 | 10 | 39.53 | 12.50 |
| | MAQ Posttest | 62.50 | 10 | 41.25 | 13.04 |

Table 3: Paired Samples Test

| | Mean | Std. Deviation | Paired Differences | | | T | Df | Sig. (2-tailed) | |
|--------|------------------------------|----------------|--------------------|-------------------------|--------|-------|------|-----------------|-------|
| | | | Std. Error Mean | 95% Confidence Interval | | | | | |
| | | | | Lower | Upper | | | | |
| Pair 1 | DKT2 Pretest - DKT2 Posttest | -6.52 | 7.74 | 2.45 | -12.06 | -.99 | - | 9 | .026 |
| Pair 2 | MAQ Pretest - MAQ Posttest | .000 | 11.78 | 3.73 | -8.431 | 8.431 | .000 | 9 | 1.000 |

Appendix A: Revised Diabetes Knowledge Test

1. The diabetes diet is:
- the way most American people eat
 - *b. a healthy diet for most people
 - too high in carbohydrate for most people
 - too high in protein for most people
2. Which of the following is highest in carbohydrate?
- Baked chicken
 - Swiss cheese
 - *c. Baked potato
 - Peanut butter
3. Which of the following is highest in fat?
- *a. Low fat (2%) milk
 - Orange juice
 - Corn
 - Honey
4. Which of the following is a "free food"?
- Any unsweetened food
 - Any food that has "fat free" on the label
 - Any food that has "sugar free" on the label
 - *d. Any food that has less than 20 calories per serving
5. A1C is a measure of your average blood glucose level for the past:
- day
 - week
 - *c. 6-12 weeks
 - 6 months
6. Which is the best method for home glucose testing?
- Urine testing
 - *b. Blood testing
 - Both are equally good
7. What effect does unsweetened fruit juice have on blood glucose?
- Lowers it
 - *b. Raises it
 - Has no effect
8. Which should not be used to treat a low blood glucose?
- 3 hard candies
 - 1/2 cup orange juice
 - *c. 1 cup diet soft drink
 - 1 cup skim milk
9. For a person in good control, what effect does exercise have on blood glucose?
- *a. Lowers it
 - Raises it
 - Has no effect
10. What effect will an infection most likely have on blood glucose?
- Lowers it
 - *b. Raises it
 - Has no effect
11. The best way to take care of your feet is to:
- *a. look at and wash them each day
 - massage them with alcohol each day
 - soak them for one hour each day
 - buy shoes a size larger than usual
12. Eating foods lower in fat decreases your risk for:
- nerve disease
 - kidney disease
 - *c. heart disease
 - eye disease
13. Numbness and tingling may be symptoms of:
- kidney disease
 - *b. nerve disease
 - eye disease
 - liver disease
14. Which of the following is usually not associated with diabetes:
- vision problems
 - kidney problems
 - nerve problems
 - *d. lung problems
15. Signs of ketoacidosis (DKA) include:
- shakiness
 - sweating
 - *c. vomiting
 - low blood glucose
16. If you are sick with the flu, you should:
- Take less insulin
 - Drink less liquids
 - Eat more proteins
 - *d. Test blood glucose more often
17. If you have taken rapid-acting insulin, you are most likely to have a low blood glucose reaction in:
- *a. Less than 2 hours
 - 3-5 hours
 - 6-12 hours
 - More than 13 hours
18. You realize just before lunch that you forgot to take your insulin at breakfast. What should you do now?
- Skip lunch to lower your blood glucose
 - Take the insulin that you usually take at breakfast
 - Take twice as much insulin as you usually take at breakfast
 - *d. Check your blood glucose level to decide How much insulin to take
19. If you are beginning to have a low blood glucose reaction, you should:
- exercise
 - lie down and rest
 - *c. drink some juice
 - take rapid-acting insulin
20. A low blood glucose reaction may be caused by:
- *a. too much insulin
 - too little insulin
 - too much food
 - too little exercise
21. If you take your morning insulin but skip breakfast, your blood glucose level will usually:
- increase
 - *b. decrease
 - remains the same
22. High blood glucose may be caused by:
- *a. not enough insulin
 - skipping meals
 - delaying your snack
 - skipping your exercise
23. A low blood glucose reaction may be caused by:
- *a. heavy exercise
 - infection
 - overeating
 - not taking your insulin

*Answer to the question.

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Appendix B: Medication Adherence Questionnaire

| | Yes | No |
|--|-----|----|
| Do you ever forget to take your medicine? | | |
| Are you careless at times about taking your medicine? | | |
| When you feel better do you sometimes stop taking your medicine? | | |
| Sometimes you feel worse, when you take the medicine, do you stop taking it? | | |