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Supporting Transitions in Care for Older Adults With Type 2 Diabetes Mellitus and Obesity

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Abstract

The aim of the current study was to compare outcomes for older adults with type 2 diabetes mellitus and obesity following participation in a transitional care intervention that included diabetes self-management education (DSME) and homecare. The three groups analyzed comprised an inpatient DSME plus homecare group ($n = 35$); an inpatient DSME only group ($n = 100$); and a group who received usual care ($n = 45$). Outcomes of interest included rehospitalization rates and hemoglobin A1C (A1C) for up to 1-year post hospital discharge. Rates of rehospitalization and A1C improved for older adults who received nurse-led inpatient DSME and homecare during transitions of care from hospital to home. Rehospitalization rates up to 90 days were decreased for the DSME plus homecare group (10%) compared to DSME only (20%) and usual care groups (26.7%) ($p < 0.05$). A decrease of -0.4 and -2.3 A1C units was observed for the DSME group and DSME plus homecare group, respectively, at 90 days. These results support a transitional care educational intervention for older adults with type 2 diabetes mellitus and obesity.

Targets—Older adults with type 2 diabetes mellitus and obesity.

Intervention Description—Transitional care intervention including diabetes self-management education and homecare.

Mechanisms of Action—Inpatient diabetes education and homecare helps improve rates of rehospitalization and hemoglobin A1C during care transitions from hospital to home.

Outcomes—Rehospitalization rates, glycemic control (i.e., A1C level).

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Currently, 30.2 million adults 18 and older in the United States have diabetes (Centers for Disease Control and Prevention [CDC], 2017). The total prevalence of diabetes is projected to increase to 25% to 28% of the U.S. adult population by 2050 (Boyle, Thompson, Gregg, Barker, & Williamson, 2010). This is a 12.8% to 15.8% increase from the current prevalence rate of 12.2%. Type 2 diabetes mellitus (T2DM) accounts for approximately 95% of all diagnosed diabetes cases in adults. A disproportionately large number of older adults are diagnosed with T2DM. Approximately 42% of patients with diabetes are adults ages 65 and older (Caspersen, Thomas, Boseman, Beckles, & Albright, 2012). Older adults who have T2DM have significantly higher morbidity and mortality when compared to older adults without T2DM (Abi Khalil, Roussel, Mohammedi, Danchin, & Maare, 2012; Gu, Cowie, & Harris, 1998; Leal, Gray, & Clarke, 2009). Diabetes contributes significantly to the economic burden of disease in the United States. Currently, one of every five U.S. health care dollars is spent to care for individuals with diabetes. Health care expenditures are higher in older adults with diabetes compared to their younger counterparts (American Diabetes Association, 2013).

Obesity is strongly associated with diabetes, and body mass index (BMI) is a powerful and modifiable risk factor for T2DM (Diabetes Prevention Program Research Group, 2002). A recent study among older adults reported that any increase in BMI above normal weight is associated with an increased risk of diabetes-related complications (Gray, Picone, Sloan, & Yashkin, 2015). The U.S. Preventive Services Task Force (2012) recommends screening all adults for obesity and offering behavioral interventions for patients with a BMI >30 kg/m². Obesity significantly affects the health status of older adults, as excess body weight correlates strongly with chronic ill health, poor quality of life, functional decline, disability, and dependency (Elia, 2001). These alarming statistics make obesity and diabetes prevention, awareness, and education major issues for health care professionals and policymakers.

The American Association of Diabetes Educators (AADE) indicates that diabetes self-management education (DSME) and support are essential components of care required to achieve desired health outcomes for individuals with diabetes (Beck et al., 2017; Funnell, Anderson, Austin, & Gillespie, 2007). The American Diabetes Association (ADA) avers that DSME is critical for all individuals with diabetes and necessary to prevent or delay diabetes-related complications (Haas et al., 2014). DSME includes providing individuals education important for diabetes self-care in the areas of recognition of signs and symptoms of the disease, dietary maintenance, exercise, self-monitoring, taking medication, managing physical and emotional distress, performing foot care, smoking cessation, and using family support and community resources (Beck et al., 2017). Research supports improved glycemic control and health outcomes for patients who receive DSME. Results of a meta-analysis of nurse-led DSME studies that included 32 randomized controlled trials (RCTs), of which two focused specifically on older adults, showed that nurse-led DSME programs were associated with a significant reduction in mean hemoglobin A1C (A1C) by 0.7% (95% confidence interval [CI] [−0.95, −0.45]) for the intervention group compared with a reduction by 0.2% (95% CI [−0.48, 0.052]) for patients who received usual care (Tshiananga et al., 2012). Sub-group analyses revealed that nurse-led DSME on glycemic control was more effective among patients 65 and older. Similarly, a systematic review of the long-term (6 months to

1.5 years) impact of DSME for older adults showed a modest but significant improvement in glycemic control (Thongsai & Youjaiyen, 2013).

Older adults' transitions from an inpatient hospital setting to home can be complex, complicated, and confusing regarding the plan of care. Disease management in older adults may differ due to the presence of geriatric syndromes such as depression, polypharmacy, cognitive impairment, urinary incontinence, history of falls, and/or persistent pain (ADA, 2016). These various processes can make management of diabetes more difficult for older adults. Patients admitted with a diagnosis of T2DM taking oral hypoglycemic medications may be transitioned to insulin during their hospital stay. Insulin requirements may fluctuate depending on severity of illness, stress, and effects of other medications during hospitalization. The discharge plan may entail a medication regimen that is different from what patients were taking prior to hospital admission. Patients new to taking any medication for their T2DM may be uncertain regarding dosage, timing, and administration. Changes in medication can be an antecedent to a hospital readmission (Eby et al., 2014).

Despite receiving written and verbal discharge instructions, many older adults remain uncertain about their plan of care after a hospital stay. This uncertainty highlights the importance of patient education starting in the hospital setting to prepare patients for the transition to home. This preparation is especially important for patients with T2DM who may require education and/or specific DSME to reinforce the importance of many self-care tasks to promote optimal diabetes management. The ADA (2016) has identified transitions as critical time points for DSME delivery. In addition to DSME, homecare can provide older adults with continued education, medication reconciliation, and safety evaluation in the home setting after hospital discharge.

The appropriate post acute care setting is important and can assist older adults in successful management of illness. Patients may receive home skilled nursing care if they meet certain eligibility criteria. For example, through Medicare, patients are eligible for home health if they are homebound, require intermittent skilled nursing care, and have a continuous physician's order for services (Centers for Medicare & Medicaid Services [CMS], 2017). Often these requirements may restrict home health care for older adults who would benefit from these services but do not meet the requirements. In addition, many older adults may benefit from DSME but are unable to attend courses in outpatient office settings due to transportation issues, timing, and/or co-pays. Providing educational opportunities to older adults as they transition from hospital to home may improve health outcomes over time.

Studies investigating interventions addressing transitions in care for patients with T2DM are limited. RCTs that have included transitional care models show a positive effect on decreasing rehospitalization rates, decreasing costs of care, and increasing patient and staff satisfaction with the discharge planning process (Coleman, Parry, Chalmers, & Min, 2006; Naylor et al., 1994; Naylor et al., 1999). These programs follow protocols designed for high-risk older adults and are not specific to older adults with T2DM and/or obesity. Existing studies investigating specific educational interventions for patients with diabetes that were provided in the hospital setting have limited or no interaction following hospital discharge.

Furthermore, a primary focus on older adults was lacking (Davies, Dixon, Currie, Davis, & Peters, 2001; Koproski, Pretto, & Poretsky, 1997; Shah et al., 2012).

Research has shown increased medical resource use for older adults with T2DM and obesity. A recent retrospective study by Raval et al. (2015) assessed readmission rates and risk factors for all-cause hospital readmission among Medicare beneficiaries ages 65 and older with T2DM. Their findings showed an all-cause 30-day readmission rate of 13.2%. A study by Hardee et al. (2015) evaluated the effectiveness of implementation of a diabetes care model in patients for whom an interdisciplinary team provided education for a safe discharge. Readmission rate at 30 days was 21.7% for patients with diabetes as the primary diagnosis and 15.9% for patients with diabetes as a secondary diagnosis after the diabetes intervention; the difference in readmission rates was not statistically significant. In addition, increased resource use and costs were associated with greater levels of BMI in a Medicare population (Suehs et al., 2017).

The current research was guided by the AADE7 Self-Care Behaviors™ (AADE7™), which includes healthy eating, being active, monitoring (e.g., blood sugar, cardiovascular health), taking medication, problem solving, reducing risks, and healthy coping (Powers et al., 2015). The AADE7 framework for measuring and evaluating behavioral outcomes recognizes four phases of DSME outcomes: (a) learning (immediate), (b) behavior change (intermediate), (c) clinical improvement (post-intermediate), and (d) improved health status (long-term) (AADE, 2011). The primary outcome for DSME is behavior change. The current research investigated A1C, a key parameter for monitoring the regulation of diabetes, in the post-intermediate phase and hospital readmission rates in the long-term phase in the DSME outcome continuum. The aim of the current study was to compare the effect of inpatient DSME plus homecare, inpatient DSME only, and usual care on hospital readmission rates and glycemic control for hospitalized older adults with T2DM and obesity. In addition, the findings of the current study were used to establish effect sizes needed for a future larger intervention study.

METHOD

Research Design

The current study was a secondary analysis of data from an intervention that was implemented in a hospital setting among patients who had a primary or comorbid diagnosis of T2DM and obesity. Patients were recruited during any medical admission to an urban academic medical center in the mid-Atlantic United States between 2006 and 2012. Adults 18 or older with T2DM and obesity were enrolled in the parent study. This secondary data analysis explored outcomes of a cohort of patients 60 or older. This population was chosen due to the lack of research investigating transitions in care for older adults with T2DM and obesity and evidence of decreased participation of older adults in DSME programs. The original project followed patients for 30 days following hospital discharge; the secondary data analysis expanded follow up to include longitudinal data available in the electronic health record (EHR) up to 12 months post hospital discharge.

Patients provided verbal consent to participate in the project. IRB approval was obtained from the University of Pennsylvania.

Outcome Measures

Outcomes were compared for differences between two intervention groups, inpatient DSME or inpatient DSME plus homecare, and a usual care group of similar patients who did not receive the intervention. The following outcomes were compared: rehospitalization rates and glycemic control (i.e., A1C level).

Rehospitalization was defined as admission to a hospital within a short period of a recent hospital stay (National Committee for Quality Assurance, 2014; Robinson, Howie-Esquivel, & Vlahov, 2012). No more than one rehospitalization was counted for each time point (30 days, 90 days, 6 months, and 12 months), consistent with measures that have been implemented by previous researchers (Jencks, Williams, & Coleman, 2009; Raval et al., 2015). The index hospital discharge date was used as baseline and any hospital readmissions up to 365 days for each patient within the study were observed. Patient transfers from a different hospital were not considered readmissions.

A1C represents the integrated glucose concentration over the preceding 8 to 12 weeks (Goldstein et al., 2004). A1C level provides a reliable measure of glycemic control and correlates with the risk of long-term diabetes complications and mortality (Khaw et al., 2004; Sherwani, Khan, Ekhzaimy, Masood, & Sakharkar, 2016). A1C was obtained from patients' laboratory blood results through the EHR at 3, 6, or 12 months after the index hospitalization.

Intervention Groups

Identification of patients for eligibility into the program included daily evaluation of inpatient census records or direct referral from hospital staff. Inclusion criteria were diagnosis of T2DM, BMI ≥ 30 kg/m², age ≥ 60 , admission to a medical floor or emergency department, residence in the city in which the health system is located, English fluency, and availability by telephone after hospital discharge.

A total of 180 individuals 60 or older were evaluated in this secondary analysis. Patients were enrolled in the parent study based on convenience sampling and assigned to groups for the purpose of the current study based on self-selection. Patients in the inpatient DSME only group received DSME provided at the hospital bedside by an advanced practice RN (APRN)-certified diabetes educator; patients in the inpatient DSME plus homecare group received DSME provided at the hospital bedside by the APRN plus continued DSME in the home provided by a visiting nurse. Patient need determined the duration of each education session and home visit as well as the number of home visits. Patients in the usual care group did not receive the inpatient DSME or homecare. The three study arms provided an opportunity to compare differences in rehospitalization rates and A1C levels based on differing active components of the education intervention.

Intervention Design

Strategies for maintaining intervention fidelity included intervention design, training of providers, and delivery of the intervention. Two APRNs (C.R.W. and another) who were also certified diabetes educators provided patient-centered, individualized inpatient diabetes education. Every patient was offered the opportunity to have a homecare nurse visit upon hospital discharge regardless of insurance or homebound status. Acceptance of this benefit determined group assignment. The diabetes education provided by the APRNs comprised education following ADA and AADE recommendations and guidelines, tailored to each patient's individual goals and needs (Haas et al., 2014; Mensing et al., 2007). There was a primary focus on education surrounding survival skills for self-management, including, but not limited to, medication administration; monitoring blood glucose; meal planning; and signs, symptoms, and treatment of hypo- and hyperglycemia (AADE, 2017).

Each patient received the name and telephone number of a contact person whom they could call in the event of an emergency or with questions concerning their diabetes or related symptoms following hospital discharge. Continued education by the homecare nurse reinforced education received in the hospital.

For individuals in the inpatient DSME plus homecare group, a homecare nurse from the health system's affiliated not-for-profit homecare agency contacted patients within 24 to 48 hours to schedule the initial home visit. The initial home visit included continued diabetes education in addition to an in-home safety assessment and medication reconciliation. Homecare nurses were provided with care plans of education that were covered during the inpatient consult. Patients who accepted homecare received at least one home visit. Patients may have received more than one home visit if the homecare nurse deemed this necessary.

Patients in the intervention groups received a follow-up phone call within 24 to 48 hours of hospital discharge and again at 30 days following hospital discharge by a project manager. Additional baseline enrollment questions were obtained at this time and a review of the discharge plan was completed with the patient. The phone call at 30 days was to inquire about any rehospitalization(s) or emergency department visit(s), provider appointment(s), and adherence to the medical treatment plan. The researcher (C.R.W.) obtained additional rehospitalization incidences and A1C levels from the EHR for up to 1-year post hospital admission for all groups. Statistical analyses were performed using SPSS version 23.

RESULTS

Sample Characteristics

A total of 180 patients were included in the data analysis and were divided into three groups: (a) inpatient DSME only ($n = 35$), (b) inpatient DSME plus homecare ($n = 100$), and (c) usual care ($n = 45$). Fifty-eight participants were male and 122 were female. Participant ages ranged from 60 to 90 years. Approximately 82% of participants were African American and 15% were White. Participants' BMI values ranged from 30 kg/m² to 64 kg/m². BMI was further grouped into obesity classifications. For obesity class I (30 to 34.9 kg/m²), obesity class II (35 to 39.9 kg/m²), and obesity class III (40 kg/m²), the frequencies were 40.6%, 31.1%, and 28.3%, respectively. Approximately one fifth (19.5%) of participants were

taking insulin in addition to an oral hypoglycemic agent to control their diabetes, 53.9% of patients were taking insulin alone, 24.4% of patients were taking an oral hypoglycemic agent alone, and 2.2% were controlling their diabetes through diet only (Table 1).

Approximately one quarter (22.8%) of patients were admitted to the hospital primarily for T2DM or a complication of T2DM (e.g., abnormal glucose, hypoglycemia, hyperglycemia, diabetes with ketoacidosis). Other diagnoses for baseline hospital admission included congestive heart failure (CHF) (8.3%), chronic obstructive pulmonary disease (8.3%), cardiac-related issues (e.g., myocardial infarction, syncope, arrhythmias, chest pain) (19.4%), infectious process (e.g., cellulitis, pneumonia, urosepsis) (10.6%), and other (e.g., renal disease, lymphedema, head injury, neurological diagnosis, fall, gastrointestinal bleed, gout, spinal stenosis, fracture, transplant) (30.6%). Length of hospital stay ranged from <24 hours to 40 days, with 42.2% having a length of stay of 2 to 3 days. The majority of participants (67.8%) did not have a hospital admission 12 months prior to the index hospitalization (Table 1).

Groups were compared for differences on baseline demographic and clinical variables. Statistically significant differences were found in median age ($p = 0.002$) and A1C level ($p = 0.031$) between the inpatient DSME plus homecare group and inpatient DSME only group, but not between the usual care and any other group. Based on the analyses, it appears that participants who received homecare were older and had higher A1C values. There were no differences observed between the intervention groups and usual care group based on gender, BMI, length of stay, race, type of diabetes discharge medication, and previous hospital admission (Table 2).

Rehospitalization Rates

At 30 days post discharge, there were no observed significant differences in relation to DSME intervention type and rehospitalization ($\chi^2(2) = 1.350$, $p = 0.509$). A statistically significant association was noted between DSME intervention and 90-day rehospitalization ($\chi^2(2) = 6.865$, $p = 0.032$). There was an inverse relationship between DSME intervention and 90-day rehospitalization rate ($\phi = 0.195$, $p = 0.032$) although the effect size was small. The DSME plus homecare group had the smallest percentage of patients who were rehospitalized (10%) compared to inpatient DSME only (20%) and the usual care group (26.7%). At 6 and 12 months post hospital discharge, there were no observed significant differences in relation to DSME intervention type and rate of rehospitalization ($\chi^2[2] = 4.035$, $p = 0.133$ and $\chi^2[2] = 1.427$, $p = 0.490$, respectively) (Table 3).

A1C Levels

The data set violated multiple assumptions of parametric statistical testing, including evidence of outliers, normality, and homogeneity. Attempts were made to transform the positively skewed data by using the logarithmic or inverse values, and extreme values were trimmed. However, these efforts failed to provide normal distributions. Because the data did not meet the assumptions for parametric testing, nonparametric tests were used. Friedman's two-way analysis of variance rank test was used to determine if there were differences in A1C levels between time points for patients with different intervention levels, as listed

above. The distributions of A1C levels were statistically significantly different over time for the inpatient DSME only group ($\chi^2[2] = 10.979, p = 0.004$) and inpatient DSME plus homecare group ($\chi^2[2] = 44.593, p < 0.001$). No statistically significant differences were observed over time for the usual care group (Table 4). The change in A1C value for inpatient DSME only from baseline to 90 days or baseline to 12 months was not statistically significant. However, a statistically significant increase in A1C was observed from 90 days to 12 months ($Z = -3.401, p < 0.001$). The Wilcoxon test showed statistically significant differences for inpatient DSME plus homecare at all time points. A significant decrease in A1C level was observed between baseline and 90 days ($Z = -5.789, p < 0.001$) and baseline and 12 months ($Z = -5.197, p < 0.001$). A significant increase in A1C was seen between 90 days and 12 months ($Z = -3.244, p < 0.001$) (Table 5).

For the group receiving inpatient DSME only, mean A1C was 7.8% ($SD = 1.7\%$) (61 mmol/mol) at baseline, 7.4% ($SD = 1.6\%$) (57 mmol/mol) at 90 days, and 7.8% ($SD = 1.7\%$) (62 mmol/mol) at 12 months. In the inpatient DSME plus homecare group, mean A1C was 9.8% ($SD = 3.3\%$) (84 mmol/mol) at baseline, 7.5% ($SD = 1.5\%$) (59 mmol/mol) at 90 days, and 7.7% ($SD = 1.7\%$) (60 mmol/mol) at 12 months. At 90 days, there was a mean change in glycemic control for the inpatient DSME only, DSME plus homecare, and usual care groups of -0.4% , -2.3% , and -1.1% A1C units, respectively. As indicated above, the statistical analysis of the rank data indicates statistically significant declines for A1C only in the inpatient DSME plus homecare group at 90 days and 12 months compared to baseline.

DISCUSSION

In 2011, the three conditions with the largest number of 30-day all-cause readmissions for Medicare patients were CHF, septicemia, and pneumonia. Diabetes-related readmissions were ranked in the top three for Medicaid and uninsured patients and in the top six for privately insured patients (Hines, Barrett, Jiang, & Steiner, 2011). Despite entering the hospital for an admission other than diabetes and obesity, many older adults may also have these complex comorbid conditions. Obesity and diabetes have been shown to increase length and therefore increase cost of stay regardless of the admitting diagnosis (Frazee, Jiang, & Burgess, 2010). Many individuals may potentially have problems and concerns regarding management of T2DM. Patients may be discharged on a new T2DM medication regimen due to changes in their medical condition. Currently, many older adults with T2DM are not receiving sufficient education to adequately manage their disease, which may lead to subsequent hospital readmissions and increases in morbidity and mortality.

According to a June 2016 report, the Medicare Payment Advisory Commission (2016) estimated that approximately 16.8% of Medicare patients discharged from acute care hospitals received home health care. Many patients do not receive the appropriate education to manage diabetes effectively, despite evidence of improved outcomes. Research by Strawbridge, Lloyd, Meadow, Riley, and Howell (2015) indicated approximately 5% of Medicare beneficiaries with newly diagnosed diabetes used DSME services up to 1 year following diagnosis. Low rates of attendance for DSME have been linked to access issues, insufficient identification of need by patient and physician, CMS requirement for physician referrals, lack of perceived value, lack of qualified educators, lack of insurance, and high co-

pays (Peyrot & Rubin, 2008; Peyrot, Rubin, Funnell, & Siminerio, 2009; Tomky, 2013). In addition, despite improved outcomes with DSME, there is insufficient evidence to identify recommendations for DSME interventions specifically in the home setting for adults (CDC, 2011; Norris et al., 2001). Many patients with T2DM receive homecare; however, there is currently no national regulatory mandate for diabetes care and education. Previous research has demonstrated positive health outcomes for homecare and DSME for older adults with T2DM (Huang, Wu, Jeng, & Lin, 2004; Ko, Lee, Kim, Kang, & Kim, 2011; Nguyen & DeJesus, 2011).

The current study included patients 60 and older. Similar to other studies, it was found that the content of DSME programs needs to be adapted to older adults with different degrees of independence and comorbidity (Dewan & Wilding, 2013). In addition, it is important for health care providers to ensure that their patients understand key points for diabetes care during their hospital admission regardless of the length of time from diagnosis with diabetes. Intervening during a hospitalization provides an opportunity to assess patients' knowledge of diabetes and their ability to complete self-management tasks, and identify potential risks that contribute to poor discharge outcomes. Patients may be referred to home health for management of a comorbid condition; for older adults with diabetes, this referral provides an opportunity to request an assessment and continued education focused on diabetes knowledge and management. Challenges exist when providing DSME in the hospital setting, and the current study highlights the importance of continued education after hospital discharge. Building on and reinforcement of foundational education in an outpatient setting is encouraged to achieve treatment goals.

STRENGTHS AND LIMITATIONS

The current study has multiple strengths. To the authors' knowledge, this is the first study to examine outcomes following an educational transitional care intervention for older adults with T2DM and obesity. The intervention provided consistent inpatient education by APRNs with expertise in diabetes education and management. Patients were assessed for their understanding of and knowledge about diabetes prior to initiation of diabetes education. This information assisted the educators in providing a curriculum that was patient specific and addressed the immediate needs of the patient. In addition, home nurses were provided with information regarding what diabetes education was covered during hospitalization and what deficits existed to focus additional education and follow up. During the hospital stay, patients were also provided with standardized handouts to reinforce the verbal education provided.

Many studies of older adults exclude patients with comorbidities. The current study is important because it included patients with one or more comorbid illnesses; however, including these patients presented a challenge when interpreting the results. The variety of comorbid conditions could have affected each of the study's outcome variables.

There are limitations to the study. Because this was a secondary data analysis and retrospective chart review, researchers were limited to the available data. Specific limitations need to be considered when using an EHR from one health system. It is possible that a

rehospitalization was underreported and not captured in the study, specifically if an individual was rehospitalized at another institution outside the health system. There were also limitations regarding available A1C levels. Patients who had their medical care managed by a provider outside the health system may not have an available A1C result recorded in the EHR. Therefore, A1C values for patients who may have had better or worse A1C levels may not have been included in the study. In the current sample, a moderate percentage did not have data collected for any time point and were subsequently excluded when A1C outcomes were calculated. This lack of data contributed to a loss of sample size, which may lead to reduced power of the statistics test. A1C can be further tested in future studies using more participants and/or an alternate measure of glycemic control.

Patients enrolled in the project represented a convenience sample and self-selected into groups. Because this was not a RCT, those who agreed to the program may have been more motivated to learn and implement diabetes self-management practices than those who declined to participate. Sampling also limits the generalizability of the results due to the narrow age range and criterion of English fluency. In addition, the sample was limited geographically; therefore, findings are not generalizable to other parts of the country.

Finally, the extent of DSME may have varied. The project was conducted over 5 years. Attempts to control for content covered during the DSME sessions included use of standardized institution-created diabetes booklets and the provision of a standardized care plan to the homecare nurses. The number and duration of homecare visits may have varied among patients. These data were unavailable for analysis; however, dose of diabetes education is an important influencing factor on outcomes. Patients in the usual care group may have received DSME at the bedside provided by the nurse caring for the patient. DSME may have varied in this group depending on time, experience, and knowledge of the nurse. A recent systematic review found that increased hours of engagement with DSME resulted in a statistically significant decrease in A1C levels (Chrvala, Sherr, & Lipman, 2016). Finally, the comparison group did not receive formal homecare following hospital discharge; therefore, it is unknown from this study if the addition of homecare only for this population would have an effect on the variables of interest.

CONCLUSION

It was anticipated that the current study would provide support for the development of recommendations for the type and site of effective educational interventions for older adults with T2DM and obesity. The overall benefits of patient education are clear. What remains to be determined is the type of education and setting that is most beneficial for hospitalized older adults with T2DM and obesity and if improvements in patient-centered outcomes can be measured over time. This research examined potential effects of different approaches to DSME after index hospitalization by analyzing rehospitalization rates and A1C levels for older adults with T2DM. The findings contribute to the literature regarding diabetes education programs for older adults with T2DM and obesity.

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TABLE 1Sample Characteristics (*N* = 180)

Variable	<i>n</i> (%)
Gender	
Female	122 (67.8)
Male	58 (32.2)
Age (years)	
60 to 69	115 (63.9)
70 to 79	50 (27.8)
80 to 89	14 (7.8)
90+	1 (0.6)
Race	
Black	148 (82.2)
White	27 (15)
Other	5 (2.8)
Type of diabetes discharge medication	
Insulin only	97 (53.9)
OHA only	44 (24.4)
OHA with insulin	35 (19.5)
None	4 (2.2)
BMI	
Obese I (30 to 34.9 kg/m ²)	73 (40.6)
Obese II (35 to 39.9 kg/m ²)	56 (31.1)
Obese III (40+ kg/m ²)	51 (28.3)
Hospital admission 12 months prior	
No	122 (67.8)
Yes	58 (32.2)
Type of admission	
Diabetes related	41 (22.8)
Cardiac	35 (19.4)
Infectious	19 (10.6)
CHF	15 (8.3)
COPD	15 (8.3)
Other	55 (30.6)
Intervention received	
Inpatient DSME plus homecare	100 (55.6)
Inpatient DSME only	35 (19.4)
Usual care	45 (25)
Length of stay (days)	

Variable	<i>n</i> (%)
0 to 1	23 (12.8)
2 to 3	76 (42.2)
4 to 5	27 (15)
6 to 40	54 (30)

Note. OHA = oral hypoglycemic agent; BMI = body mass index; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DSME = diabetes self-management education.

TABLE 2

Differences in Demographic Data Between Groups

Variable	Inpatient DSME Only (<i>n</i> = 35)	Inpatient DSME Plus Homecare (<i>n</i> = 100)	Usual Care (Control) (<i>n</i> = 45)	<i>p</i> Value
Gender (<i>n</i> [%])				0.858 ^a
Female	24 (68.6)	69 (69)	29 (64.4)	
Male	11 (31.4)	31 (31)	16 (35.6)	
Age (years) (mean [<i>SD</i>])	65.85 (4.9)	69.89 (6.9)	68.65 (6.3)	0.003 ^{b,c}
Race (<i>n</i> [%])				0.853 ^a
Black	30 (85.7)	83 (83)	35 (77.8)	
White	4 (11.4)	14 (14)	9 (20)	
Other	1 (2.9)	3 (3)	1 (2.2)	
Discharge medication (<i>n</i> [%])				0.035 ^{a,d}
Insulin only	17 (48.6)	52 (52)	28 (62.2)	
OHA only	13 (37.1)	24 (24)	7 (15.6)	
OHA with insulin	4 (11.4)	24 (24)	7 (15.6)	
None	1 (2.9)	0 (0)	3 (6.7)	
BMI (mg/k ²) (mean [<i>SD</i>])	36.62 (5.7)	38.01 (6.8)	37.45 (6.4)	0.375 ^b
Type of admission (<i>n</i> [%])				0.004 ^{a,e}
Diabetes related	8 (22.9)	26 (26)	7 (15.6)	
Cardiac	8 (22.9)	20 (20)	7 (15.6)	
Infectious	5 (14.3)	12 (12)	2 (4.4)	
CHF	1 (2.9)	14 (14)	0 (0)	
COPD	3 (8.6)	8 (8)	4 (8.9)	
Other	10 (28.6)	20 (20)	25 (55.6)	
LOS (days) (mean [<i>SD</i>])	3.37 (3.2)	5.23 (4.7)	4.81 (5.0)	0.016 ^{b,c}

Note. DSME = diabetes self-management education; OHA = oral hypoglycemic agent; BMI = body mass index; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; LOS = length of stay.

^aChi-square.

^bKruskal-Wallis.

^cStatistically significant at $p < 0.05$.

^dNot significant at the adjusted alpha = 0.004.

^eNot significant at the adjusted alpha = 0.003.

TABLE 3

Rehospitalization Rates at 30 Days, 90 Days, 6 Months, and 12 Months Post Index Hospital Discharge

Time Point	<i>n</i> (%)			<i>p</i> Value
	Inpatient DSME Only (<i>n</i> = 35)	Inpatient DSME Plus Homecare (<i>n</i> = 100)	Usual Care (<i>n</i> = 45)	
30 days	4 (11.4)	11 (11)	8 (17.7)	0.509
90 days	7 (20)	10 (10)	12 (26.7)	0.032 ^a
6 months	5 (14.2)	6 (6)	7 (15.5)	0.133
12 months	6 (17.1)	19 (19)	12 (26.7)	0.490

Note. DSME = diabetes self-management education.

^aStatistically significant ($p < 0.05$).

TABLE 4

Friedman Test Comparison Regarding Hemoglobin A1C Levels in Usual Care, Inpatient DSME Only, and Inpatient DSME Plus Homecare Groups at Baseline, 90 Days, and 12 Months Post Index Hospital Discharge

Group	HbA1C			χ^2	Df	p Value
	Time	Mean (SD)	Mean Rank			
Usual care (<i>n</i> = 27)	Baseline	8.7 (2.997)	2.07	2.889	2	0.236
	90 days	7.6 (1.459)	1.74			
	12 months	7.7 (1.266)	2.19			
Inpatient DSME only (<i>n</i> = 24)				10.979	2	0.004 ^a
	Baseline	7.8 (.703)	1.79			
	90 days	7.4 (1.591)	1.67			
Inpatient DSME plus homecare (<i>n</i> = 81)	12 months	7.8 (1.734)	2.54			
				44.593	2	<0.001 ^a
	Baseline	9.8 (3.253)	2.53			
	90 days	7.5 (1.510)	1.49			
	12 months	7.7 (1.718)	1.98			

Note. DSME = diabetes self-management education.

^aStatistically significant ($p < 0.05$).

TABLE 5

Wilcoxon Signed Rank Test of Significant Hemoglobin A1C Time Interactions

Group	Post Hoc Analysis	Rank	Mean Rank	Sum of Ranks	Z	p Value
Inpatient DSME only	Baseline to 90 days	9–	16.11	145	–0.601	0.548
		13+	8.31	108		
		Ties 2				
	90 days to 12 months	2–	15.5	31	–3.401	0.001 ^a
		22+	12.23	269		
		Ties 0				
Inpatient DSME plus homecare	Baseline to 12 months	9–	14.44	130	–0.572	0.568
		15+	11.33	170		
		Ties 0				
	Baseline to 90 days	61–	45.60	2827	–5.789	<0.001 ^a
		18+	22.94	413		
		Ties 1				
	90 days to 12 months	19–	44.03	836.5	–3.244	0.001 ^a
		57+	36.66	2089.5		
		Ties 5				
	Baseline to 12 months	61–	44.32	2703.5	–5.197	<0.001 ^a
		19+	28.24	536.5		
		Ties 1				

Note. DSME = diabetes self-management education.

^aStatistically significant at adjusted alpha = 0.017.