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BRIEF REPORT

Increasing Diabetes Self-Management Education and Support Referrals with an Electronic Best Practice Advisory

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Introduction: Diabetes self-management education and support (DSMES) services are often underutilized, partly due to low referral rates by clinicians. This examines if using a Best Practice Advisory (BPA) integrated into the electronic health record (EHR) during clinic visits increases DSMES referral rates.

Methods: We developed a BPA within the Epic EHR for patients with type 2 diabetes (T2D) eligible for DSMES services. This BPA was implemented in four primary care practices within a university-based health system, while two additional practices served as controls. We analyzed data using multilevel logistic regression with patient data nested within clinicians. We employed binary logit functions and maximum likelihood estimation to assess the odds of DSMES referrals postvisit. Both unadjusted and adjusted models were tested, accounting for clinic and patient variables.

Results: From April 1, 2023, to March 31, 2024, 2,526 BPAs were deployed in intervention clinics, resulting in a 12.9% DSMES referral rate. In contrast, control clinics had 1,444 eligible patient visits with a 1.2% referral rate ($p<0.001$).

Conclusions: Integrating BPA prompts into the EHR significantly enhances DSMES referral rates. This approach effectively identifies eligible patients and simplifies the referral process, addressing some barriers to DSMES utilization.

Keywords: Best Practices, Electronic Health Record, Family Medicine, Logistic Regression, Patient Education, Primary Health Care, Randomized Controlled Trial, Referral and Consultation, Self-Management, Type 2 Diabetes Mellitus

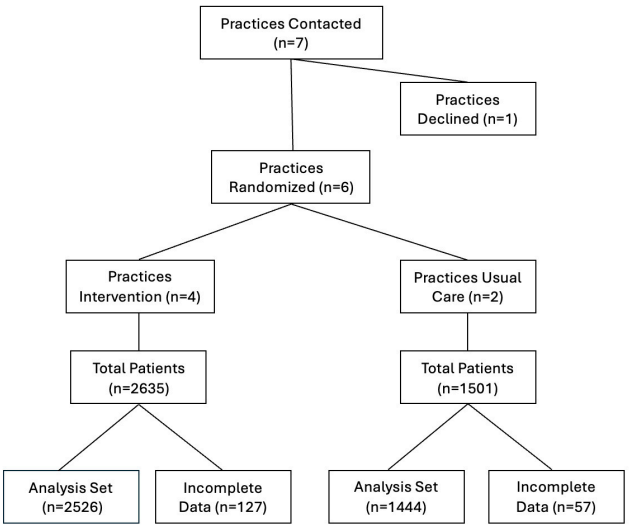
Introduction

Diabetes Self-Management Education and Support (DSMES) classes offer a structured approach to help people living with diabetes mellitus (PWDM). PWDM who receive DSMES services experience improvements in diabetes care[1-4] and reduce the onset and/or worsening of diabetes-related complications resulting in lower all-cause mortality.[5-7] Despite benefits, few receive DSMES services with an estimated 6.8% of privately insured[8] and 5% of Medicare enrollees receiving DSMES services within the first year of diabetes diagnosis.[9]

Clinicians face numerous barriers to completing DSMES referrals, including a lack of awareness, unclear referral processes, and unconscious bias (i.e., assuming patients will be unwilling/unable to engage in DSMES).[10,11] Few trials assess clinician and patient barriers to DSMES services within real-world primary care settings. In one cohort study clinicians in six practices referred patients to DSMES classes offered within their practices while those in another six practices referred to hospital based classes and found modestly higher referral (18.4% vs. 13.4%; P < .0001) and attendance rates (34.9% vs. 26.1%; P = .02) for the within practice option.[12] In a study within a single federally qualified health center, an embedded electronic health record (EHR) DSMES algorithm supported enhanced referrals.[13]

"Best Practice Alerts" (BPAs) are automated alerts embedded in EHR systems that provide clinicians with reminders at the point of care. BPAs can help enhance clinician knowledge and efficiency.[14] While some studies suggest BPAs guide people to the care they need,[4,14-23] other studies have been less compelling. Additionally, these studies used retrospective designs[15,17,19,23] or were not designed *a priori* to rigorously test for an independent effect of a BPA.[21,22] While promising, more evidence is needed to determine the success of BPAs in prompting clinician behavior change, especially regarding DSMES referrals.[15,20]

Figure 1. CONSORT Flow Diagram for Study Enrollment.



Given the time strains on primary care clinicians (PCPs), DSMES services can improve diabetes outcomes, if physician and patient barriers are addressed. This study examines the comparative effectiveness of BPAs on physician referrals to DSMES group classes among six primary care clinics.

Methods

Study Design, Population, and Setting

We conducted a prospective, cluster-randomized trial involving 3,970 adults with type 2 diabetes across six private primary care practices within a primary care network affiliated with an academic health system in North Carolina. Four practices were randomized to the intervention group (BPA) and two to the control group (no BPA) (Figure 1). Prior to study activation, all six practices received a one-hour continuing medical education session reviewing the benefits of DSMES and provided advice regarding BPA development.

Participants

Adults with type 2 diabetes who had face-to-face visits with their primary care clinicians between 4/1/2023 and 3/31/2024 and met eligibility for DSME class referral were included. For intervention practices, a BPA triggered at each clinic visit when patients met one or more of the following criteria as indicated by a threshold hemoglobin A1C laboratory value (> 8.5%) or via Current Procedural Terminology (CPT) codes: new diagnosis of type 2 diabetes; new diagnosis of a diabetes related complication specified as new neuropathy, myocardial infarction, stroke, foot ulcer, retinopathy, or peripheral vascular disease; or hospitalization noted in the EHR within 3 months of the index primary care visit.

Intervention Arm/BPA Creation

We engaged primary care clinicians, diabetes educators, and informatics experts in the BPA development and testing. We created a "tip sheet" to guide staff and clinicians on how to use and understand BPA functionality. A practice facilitator provided on-site support at each intervention practice to help with BPA implementation.

Practice Randomization

To attempt to balance socioeconomic status of practice populations across study arms, we used a stratified cluster random sampling strategy using two insurance measures (% of patients covered by Medicaid and % covered by Medicare) as randomization strata variables.

Data Analysis

We used descriptive statistics to summarize patient and practice sample characteristics overall and by study arm. We applied the chi-square test for categorical variables and the t-test for continuous variables. Mean difference t-tests were conducted for continuous variables, including age, comorbidity count, number of appointments with PCPs within 12 months, and number of DSMES eligibility criteria. Pearson chi-square tests were performed between the practice type (i.e., control versus intervention practices) and patient-level categorical variables, including sex, race, ethnicity, marital status, rurality, insurance type, and reason for firing BPA. The primary outcome, referral rates to DSMES class within 30 days of a PCP visit, was examined with multilevel mixed logistic models estimating the odds of referral between patients in intervention vs. control practices controlling for age, sex, race, ethnicity, marital status, insurance status, rurality, comorbidities, and eligibility for DSMES class. This modeling approach accounts for the clustering of patients within each practice, improving the accuracy of the standard error estimates.[18] Patients with incomplete demographic data were excluded from the final analysis data set (Figure 1). We considered a significance level $p < 0.05$ for the bivariate and multivariate analyses. The UNC Chapel Hill Institutional Review Board approved the study.

Results

In this study, 3,970 patients with diabetes across the six practices qualified for DSMES classes (Table 1). The average age was 64.9 years, with 56.6% being female. The majority were White patients (64.1%), followed by Black patients (30.5%). Most were married (54.6%), had Medicare insurance coverage (59.5%), lived in urban areas (95.9%), and had an average of 4.3 primary care office visits in the year prior to their index PCP visit. Compared to control clinics, there was a higher proportion of patients in the intervention arm practices with newly diagnosed patients (28.5% vs 20.5%) and lower proportion with new diabetes-related comorbidities (37.7% vs 44.1%). Over 12 months, intervention

Table 1. Baseline Characteristics of Patients Eligible for Diabetes Self-Management Education Support (DSMES) Services, N = 3,970.

	Control Practices (N=2)	Intervention Practices (N=4)	Total (N=6)	P-Value
Total Patients	1,444 (36.4%)	2,526 (63.6%)	3,970 (100%)	---
Age (SD)	65.7 (15.9)	64.4 (15.0)	64.9 (15.3)	**0.010**
Sex				0.053
Male	598 (41.4%)	1,126 (44.6%)	1,724 (43.4%)	
Female	846 (58.6%)	1,400 (55.4%)	2,246 (56.6%)	
Race				0.112
White	960 (66.5%)	1,583 (62.7%)	2,543 (64.1%)	
Black	409 (28.3%)	802 (31.7%)	1,211 (30.5%)	
Asian	30 (2.1%)	53 (2.1%)	83 (2.1%)	
Other	45 (3.1%)	88 (3.5%)	133 (3.4%)	
Ethnicity				0.346
Non-Hispanic	1,397 (96.7%)	2,457 (97.3%)	3,854 (97.1%)	
Hispanic	47 (3.3%)	69 (2.7%)	116 (2.9%)	
Marital Status				**0.048**
Married	818 (56.6%)	1,349 (53.4%)	2,167 (54.6%)	
Other Statuses	626 (43.4%)	1,177 (46.6%)	1,803 (45.4%)	
Rurality				0.035
Urban	1,372 (95.0%)	2,435 (96.4%)	3,807 (95.9%)	
Rural	72 (5.0%)	91 (3.6%)	163 (4.1%)	
Insurance				**0.000**
Commercial	402 (27.8%)	926 (36.7%)	1,328 (33.5%)	
Medicaid	85 (5.9%)	139 (5.5%)	224 (5.6%)	
Medicare	939 (65.0%)	1,423 (56.3%)	2,362 (59.5%)	
Self-Pay	18 (1.2%)	38 (1.5%)	56 (1.4%)	
Comorbidity Count (SD)	1.6 (1.3)	1.6 (1.2)	1.6 (1.3)	0.124
Number of primary care appointments in past year (SD)	4.4 (3.1)	4.2 (2.9)	4.3 (3.0)	0.150
DSMES Eligibility Criteria*				
A1C>8.5	324 (22.4%)	573 (27.7%)	897 (22.6%)	0.858
New diabetes diagnosis	296 (20.5%)	720 (28.5%)	1,016 (25.6%)	**<0.001**
Hospitalization	507 (35.1%)	933 (36.9%)	1,440 (36.3%)	0.250
New diabetes related comorbidities	637 (44.1%)	952 (37.7%)	1,589 (40.0%)	**<0.001**
Number of Eligibility Criteria (SD)	1.2 (0.5)	1.3 (0.5)	1.2 (0.5)	**0.030**
DSMES order placed	18 (1.2%)	325 (12.9%)	343 (8.6%)	**<0.001**

*Each criterion is coded as a binary variable, and the table shows only the percentage of patients who meet each criterion. Patients may be eligible for more than one criterion.

clinics placed more DSMES class referral orders than control clinics (325 vs. 18, p<0.001).

Among all six clinics, Black patients were more likely to be referred for DSMES services (OR 1.55, 95% CI: 1.19-2.02) vs. Whites. Hispanic patients had a higher likelihood of re-

Table 2. Multilevel Mixed Logit Models Estimating Odds Ratios of Referral for Diabetes Self-Management Education Support (DSMES) Services During Clinic Visits

	Model 1 (Unadjusted)		Model 2 (Adjusted)	
	OR	95% CI	OR	95% CI
Intervention clinic	10.64***	[4.96, 22.9]	**10.55*** **	[4.65, 23.94]
Age			0.99	[0.98, 1.01]
Female			0.93	[0.73, 1.19]
Race (ref: White)				
Black			**1.55** **	[1.19, 2.02]
Asian American			1.31	[0.64, 2.68]
Other			0.68	[0.32, 1.46]
Hispanic			**2.16** *	[1.05, 4.43]
Married			0.97	[0.75, 1.25]
Rural			1.00	[0.53, 1.87]
Insurance (ref: Commercial)				
Medicaid			1.01	[0.57, 1.78]
Medicare			0.87	[0.61, 1.25]
Self-Pay			0.73	[0.24, 2.21]
Comorbidity Count			**1.26** ***	[1.13, 1.40]
Number of primary care appointments in past year			0.96	[0.92, 1.00]
Reason for referral (ref: Hospitalization)[a]				
A1C>8.5			**3.78** ***	[2.52, 5.68]
New diabetes diagnosis			**5.72** ***	[3.90, 8.41]
New diabetes-related comorbidities			1.39	[0.93, 2.06]
Intercept	0.01***	[0.01, 0.02]	**0.01** ***	[0.00, 0.02]

Notes: Odds ratios with 95% confidence intervals in brackets are shown.
[a] Reason for referral is a four-category nominal variable with hospitalization as the reference group.
* p<0.05, ** p<0.01, *** p<0.001

ferral (OR 2.16, 95% CI: 1.05-4.43) vs. non-Hispanic patients. Patients with more comorbidities had an increased referral rate (1.26, 95% CI: 1.13-1.40). Those with A1c >8.5 (OR 3.78, 95% CI: 2.52-5.68), and patients with newly diagnosed diabetes (OR 5.72, 95% CI: 3.90-8.41) were more likely to be referred for DSMES services compared to patients who met eligibility by having a hospitalization within 3 months of their index visit with their PCP. After adjusting for socio-demographic variables, patients in intervention practices had higher odds of DSMES referral compared to control practice patients (OR 10.55, 95% CI: 4.65-23.94) (Table 2).

Discussion

Our findings suggest implementing the BPA improved DSMES class referral rates. Among all six practices (control and intervention), we also observed higher odds of referrals to DSMES classes among higher-risk patient populations, including Black patients, Hispanic patients, and patients with other chronic comorbidities. Additionally, patients with newly diagnosed diabetes and worse glycemic control had higher odds of being referred to DSMES group classes.

Leading organizations identify four critical time points for DSMES services to take place: 1) diagnosis, 2) annually and/or when not meeting treatment targets, 3) when complicating factors develop, and 4) when transitions in life and care occur.[24] BPAs are a promising approach for increasing referral rates. The BPA is a tool designed to encourage discussion between the clinician and the patient about the benefit of DSMES services. However, they are not positively viewed by all clinicians. BPAs support adherence to evidence-based recommendations at the point of care, but they can be a source of alert fatigue.[16] If poorly implemented, they disrupt the clinical visit workflows.[25] Complementary interventions including staff education and standing orders, as well as timely access to DSMES services could be used to address clinician referral inertia to DSMES services.

Ultimately, the BPA is just one tool to identify populations eligible for services and is only one step in the process. While referral rates increased in our study, there remains a gap between referrals and actual class attendance. In addition to clinician barriers above, patient barriers include patient refusals, cost and lack of same day interventions for DSMES. Healthcare systems need to adopt strategies that address the many steps between identifying eligible patients and their having services completed, such as enhancing patient outreach and motivation via follow-up calls and/or automated reminders. Additionally, offering classes during evening and weekend hours as well as tele-

health options may be useful ways to address patient transportation and access barriers. Another tactic to increase patient engagement could include point of care scheduling for DSMES services. It is standard for diabetes care educators to culturally tailor interventions however successfully accomplishing this is variable and can affect patient engagement.

Our results need to be considered within their limitations. Due to limited referral numbers in our control practices, we did not estimate odds ratios of DSMES referrals differing by patient characteristics. We included six private primary care practices in NC, thus findings might not apply to other clinic types and EHR's used or those without available DSMES services. The goal of this work was to focus on increasing referrals; these analyses did not examine additional outcomes including scheduled appointments for DSMES, and associated DSMES clinical outcomes.

The BPA approach could be adapted for other EHR systems. To fully unlock the potential of BPAs, the focus needs to go beyond just increasing referrals; we also need to streamline the process from referral to DSMES participation. Ongoing collaboration between clinical teams, IT, patients, and community partners to continually improve the BPA system and the delivery of DSMES to ensure that patients get referred and receive the education and support they need for effective diabetes self-management is critical.

Conclusions

Few eligible patients currently receive DSMES services. Using a BPA is a promising strategy that prompts clinicians to consider referring patients to DSMES.

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Conflicts of Interest

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Trial Registration

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