



# Identifying factors affecting diabetes education program participation within a metro Detroit integrated health system

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## ABSTRACT

Diabetes self-management education and support (DSMES) can help people achieve optimal disease control, yet these services often remain underutilized. People referred to these programs by their provider can become disengaged in the program at several key steps. This study applies Classification and Regression Tree analysis to 3796 people with diabetes at a single health system based in the Detroit metropolitan area who were referred for DSMES provided by the health system to determine demographic patterns of those who were successfully contacted to schedule program intake appointments, those who did not attend their intake appointment, and those who began but did not complete their personalized DSMES program. White people > 43 years of age, those with a prior A1C value > 8.9 and those with Medicaid insurance had the highest rate of not being successfully contacted for their intake appointment. Those who did not attend their intake appointment tended to have Medicaid insurance, be younger than 48 years, and have A1C > 8.1. Within the Medicare or private insurance groups, those who did not attend were more likely to be female, of Black race and not partnered. Older males with a lower A1C ( $\leq 8.3\%$ ) had the lowest rate (34.0%) of failing to complete their DSMES plan. The data showed that almost half of those referred were not successfully contacted. The overall low completion rate of 13.2% confirms the need to examine factors predictive of participation and completion. This study highlights process improvement changes to improve personalization of outreach and engagement.

## 1. Introduction

In the United States, 34.2 million people (10.5% of the population) have diabetes; however, 7.3 million (21.4%) of these are undiagnosed (Centers for Disease Control and Prevention, 2020). In 2017, diabetes was the seventh leading cause of death in both Michigan and the United States (Murad and Daniel-Wayman, 2019). In 2017, an estimated 11.0% of adults in Michigan reported being told by a provider that they had diabetes with higher prevalence rates among Black, non-Hispanic adults (14.6%) compared with White, non-Hispanic adults (10.5%) (Murad and Daniel-Wayman, 2019). Wayne County Michigan, home of Detroit, has a high prevalence of diabetes (12.0%) and obesity (34.7%) (Fos et al., 2020). The single best action a patient with diabetes can take to improve their health is to achieve and maintain their glycemic target. However, people with diabetes can face considerable self-management demands

which, when combined with concern about potential or actual disease progression, are directly associated with reports of diabetes distress (Fisher et al., 2012). Diabetes distress prevalence is reported to be 18%–45% with an incidence of 38%–48% over 18 months (Aikens, 2012).

Diabetes self-management education and support (DSMES) is recommended for all people with diabetes, and is effective in improving the likelihood of a patient achieving their glycemic target (Powers et al., 2020). However, the challenges of self-management heightens when social circumstance impact a person's ability to participate. The 2020 National Standards for DSMES emphasize that providers should identify and address barriers affecting participation in DSMES services following referral; and that health policy, payers, health systems, providers, and health care teams should identify and address barriers influencing providers referrals (Powers et al., 2020).

The effectiveness of DSMES has been well documented in

*Abbreviations:* BMI, body mass index; CART, Classification and Regression Tree; DSMES, diabetes self-management education and support; EMR, electronic medical record; HFHS, Henry Ford Health System.

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**Table 1**  
DSMES program engagement of 3,769 subjects.

	Count (Percentage)
Referral only (patient not successfully contacted)	1868 (49.6)
Successfully contacted and did not attend intake appointment	588 (15.6)
Attended intake appointment and did not finish DSMES plan	816 (21.6)
Completed the DSMES plan	497 (13.2)

DSMES, diabetes self-management education and support

randomized controlled trials comparing diabetes self-management education with usual care (He et al., 2017). These studies demonstrated that diabetes self-management education can reduce all-cause mortality risk in people with Type 2 diabetes (He et al., 2017). Despite this, the continued disparity in diabetes outcomes for racial-ethnic minorities, low income and other marginalized populations urges us to more closely examine the patient care process and system level factors that may contribute to this disturbing trend (Joensen et al., 2019).

Henry Ford Health System (HFHS) offers an array of education, support and medication optimization programs that teach people to manage their Type 2 diabetes. However, we estimate that > 60% of people with Type 2 diabetes have not yet achieved their glycemic target despite the numerous programs available. DSMES programs may be effective for many of the people who participate; yet a significant number of people are either not referred by the provider or do not enroll in or complete these programs.

This study examines efforts at our large integrated tertiary health system to continuously improve access to and participation in DSMES services. The overall goal of this project was to identify characteristics associated with participation in the DSMES program enrollment at several key engagement steps and to explore interventions to address enrollment and completion gaps. Our initial specific questions were the following:

- 1: What are the demographic characteristics of the referred people successfully contacted to schedule an intake appointment?
- 2: What are the demographic characteristics of the successfully contacted people that make a DSMES intake appointment but never attend the intake appointment?
- 3: What are the demographic characteristics of the people that complete at least 1 but not all DSMES sessions in their personalized plan (“Incomplete”) as compared with those who complete all sessions?

## 2. Methods

### 2.1. The program

The array of DSMES services at HFHS includes diabetes support groups, medical nutrition therapy with a dietitian, intensive titration of medications with a nurse and American Diabetes Association certified diabetes management classes. All HFHS physicians can refer their patients to these programs by initiating an order in the Epic electronic medical record (EMR; Epic Systems Corporation, Verona, WI), which is used across the entire health system. The patient’s name and medical record number in Epic are then sent electronically to the DSMES team where individuals are placed into a queue so that they may be contacted to invite participation in the DSMES services. Once patients are referred by their provider, successful participation in DSMES requires the following steps:

1. A staff member contacts the person with Type 2 diabetes to schedule an intake appointment.
2. The person with diabetes attends the intake appointment to develop a personalized plan of DSMES sessions.
3. People complete their personalized planned DSMES sessions.

**Table 2**  
Demographic characteristics of 3,769 people.

Characteristic	N (%)	
Gender		
Female	2078 (55.1)	
Male	1691 (44.9)	
Marital status <sup>a</sup>		
Not partnered	1821 (49.3)	
Partnered	1873 (50.7)	
Race		
Black	1842 (48.9)	
White	1428 (37.9)	
Other <sup>b</sup>	247 (6.5)	
Decline/No response	252 (6.7)	
Insurance		
Medicaid	709 (18.8)	
Medicare	814 (21.6)	
Other/unknown	86 (2.3)	
Private	2160 (57.3)	
Age grouping		
Under 40	445 (11.8)	
40-<50	626 (16.6)	
50-<60	1074 (28.5)	
60-<70	1006 (26.7)	
70 and up	616 (16.4)	
Ever any tobacco product <sup>c</sup> consumed?		
Yes	1313 (35.7)	
No	2361 (64.3)	
Had at least 1 A1C measure in 2 years prior to referral date?		
Yes	3524 (93.5)	
No	245 (6.5)	
Mean age at referral date (SD), in years		56.8 (13.6)
Mean BMI prior to referral date (SD)		35.1 (8.1)
A1C value prior to referral date (categorized):		
6.5-7	827 (23.5)	
7-<8	689 (19.5)	
8-<10	789 (22.4)	
10-<12	430 (12.2)	
12 and up	377 (10.7)	
Median A1C value prior to referral date (IQR) <sup>d</sup>		7.7% (6.7%-9.7%)Min = 4.8%Max = 18.5%

BMI, body mass index; IQR, interquartile range; Max, maximum; Min, minimum; SD, standard deviation.

<sup>a</sup> n = 75 with missing marital status data

<sup>b</sup> n = 247 other race includes: 112 Asian, 13 American Indian/Alaska Native, 7 Native Hawaiian/Pacific Islander, 5 Hispanic, 3 Middle Eastern, and 100 Other (not specified)

<sup>c</sup> As recorded in electronic medical record, cigarettes, pipes, snuff, or chew, N = 95 with missing information

<sup>d</sup> Interquartile range, which is defined so that the 25th percentile is 6.7 and the 75th percentile is 9.7, and the 50th percentile (median) is 7.7

**Table 3**  
Comparing referred people not successfully contacted to those successfully contacted.

Successfully Contacted, N (%)		No (N = 1868)	Yes (N = 1901)	P-value*
Covariate	Level			
Age at referral	Under 40	266 (14.2%)	179 (9.4%)	<0.05
	40-<50	325 (17.4%)	301 (15.9%)	
	50-<60	523 (28%)	551 (29%)	
	60-<70	478 (25.6%)	528 (27.8%)	
	70 and up	276 (14.8%)	340 (17.9%)	
Gender	Female	961 (51.4%)	1117 (58.8%)	<0.05
	Male	907 (48.6%)	784 (41.2%)	
Race	Black	794 (42.5%)	1048 (55.1%)	<0.05
	Decline/Unknown	122 (6.5%)	130 (6.8%)	
	Other	148 (7.9%)	99 (5.2%)	
	White	804 (43%)	624 (32.8%)	
Marital status	Not partnered	884 (48.3%)	937 (50.3%)	0.221
	Partnered	947 (51.7%)	926 (49.7%)	
Insurance	Medicaid	382 (20.4%)	327 (17.2%)	<0.05
	Medicare	353 (18.9%)	461 (24.3%)	
	Other/unknown Private	49 (2.6%)	37 (1.9%)	
Ever any tobacco products	No	1169 (64.4%)	1192 (64.2%)	0.891
	Yes	647 (35.6%)	666 (35.8%)	
Had at least 1 A1C measure in 2 years prior to referral date	No	148 (7.9%)	97 (5.1%)	<0.05
	Yes	1720 (92.1%)	1804 (94.9%)	
A1C value prior to referral date (in %)	N	1720	1804	0.175
	Median	7.7	7.6	
	25th percentile	6.7	6.7	
	75th percentile	9.8	9.6	
	Mean	8.5	8.4	
BMI prior to referral date, kg/m <sup>2</sup>	N	1781	1846	0.637
	Mean (SD)	35 (8.3)	35.1 (8)	
Age at referral	N	1868	1899	<0.05
	Mean (SD)	55.7 (14)	57.9 (13.1)	

BMI, body mass index; SD, standard deviation.

\*The parametric p-value is calculated by analysis of variance for numerical covariates, except A1C where values were non-normally distributed, so a Wilcoxon rank sum test was performed, and chi-square test for categorical covariates.

## 2.2. People and data

The medical record numbers from all patients with Type 2 diabetes referred to the HFHS DSMES program between October 1, 2018 and September 30, 2019 (n = 3794) were compiled. Queries were run using the Epic Clarity data warehouse, derived from Epic EMR data, to collect additional descriptive data on these individuals. As some data change

over time, the information taken closest and prior to the DSMES referral date was used. Data collected include patient sex, body mass index (BMI) in kg/m<sup>2</sup>, insurance type, marital status, race, age, ever used tobacco, and all glycated hemoglobin A1C (A1C) measures in the last 2 years. The study was approved by the HFHS Institutional Review Board (Protocol #13625).

## 2.3. Analyses

Descriptive statistics were calculated to describe these people with Type 2 diabetes (mean, standard deviations, medians, and quartiles). Comparisons across groups were made using analysis of variance, Wilcoxon rank sum tests and chi-square tests. We then used Classification and Regression Tree (CART) analyses to examine which of a limited set of variables (age, race, gender, partnered, prior BMI, A1C value, smoking status, and documented insurance) are most important in predicting each of the binary outcomes of interest (i.e., intake appointment made, attended intake appointment, and DSMES program completed). Using CART analyses, we can build a decision tree by sequentially selecting optimal splits in the data (i.e., each variable) to maximize the prediction of the outcome variable. The first split is the single best classifier of the outcome variable. All possible binary splits are considered for both categorical and continuous variables, and variables can be repeated (e.g., age may be a split near the top of the tree and again further down the tree) to reflect complex interactions. The color of the nodes on the tree are red if they had a percentage > 51% vs green for those that had a percentage < 50% of the desired outcome.

## 3. Results

Of the 3794 people with Type 2 diabetes referred to the DSMES, 25 died during the follow-up period and were excluded leaving an analytic sample size of 3769. The overall breakdown of progress through the program is reported in Table 1, with a 13.2% overall rate of DSMES program completion. Of the 3769 people, 44.9% (n = 1691) are male and 55.1% (n = 2078) are female and nearly half were of Black race (48.9%). The average age was 56.8 years old at time of provider referral (standard deviation = 13.6), with a range from 10 years to 99 years. Most people had private insurance (57.3%), nearly two-thirds (64.3%) reported never using tobacco products, and the average BMI was 35.1 kg/m<sup>2</sup> (standard deviation = 8.1) (Table 2). At least one A1C measurement was available for 93.5% of the study population (n = 3524). The median A1C value closest and prior to the referral date was 7.7% (25th percentile = 6.7%; 75th percentile = 9.7%) with 11.7% (n = 412) of the A1C measures < 6.5% (diagnostic) and 10.7% (n = 377) of the A1C measures > 12% (Table 2).

### 3.1. What are the demographic characteristics of the referred people successfully contacted to schedule a DSMES intake appointment?

Table 3 compares the 1868 (49.6%) of people not successfully contacted with the 50.4% (n = 1901) successfully contacted. Those not successfully contacted tended to be younger, male gender and were more likely to be White. They were also more likely to be on Medicaid vs Medicare insurance. There was no statistically significant difference in contact success based on whether the patient reported a "partnered" marital status (i.e., married or significant other) or whether they had a record of ever using tobacco. Those not successfully contacted were less likely to have a prior A1C value available via the EMR (92.1% vs 94.9%); however, the distributions of actual A1C value and prior BMI were not statistically significantly different between those who were successfully contacted and those who were not successfully contacted.

We then used CART to identify which of a limited set of variables (age, race, gender, partnered, prior BMI, A1C value, smoking status, and insurance type) are most important in predicting those who were "not successfully contacted" (Fig. 1). The overall rate of "not successfully

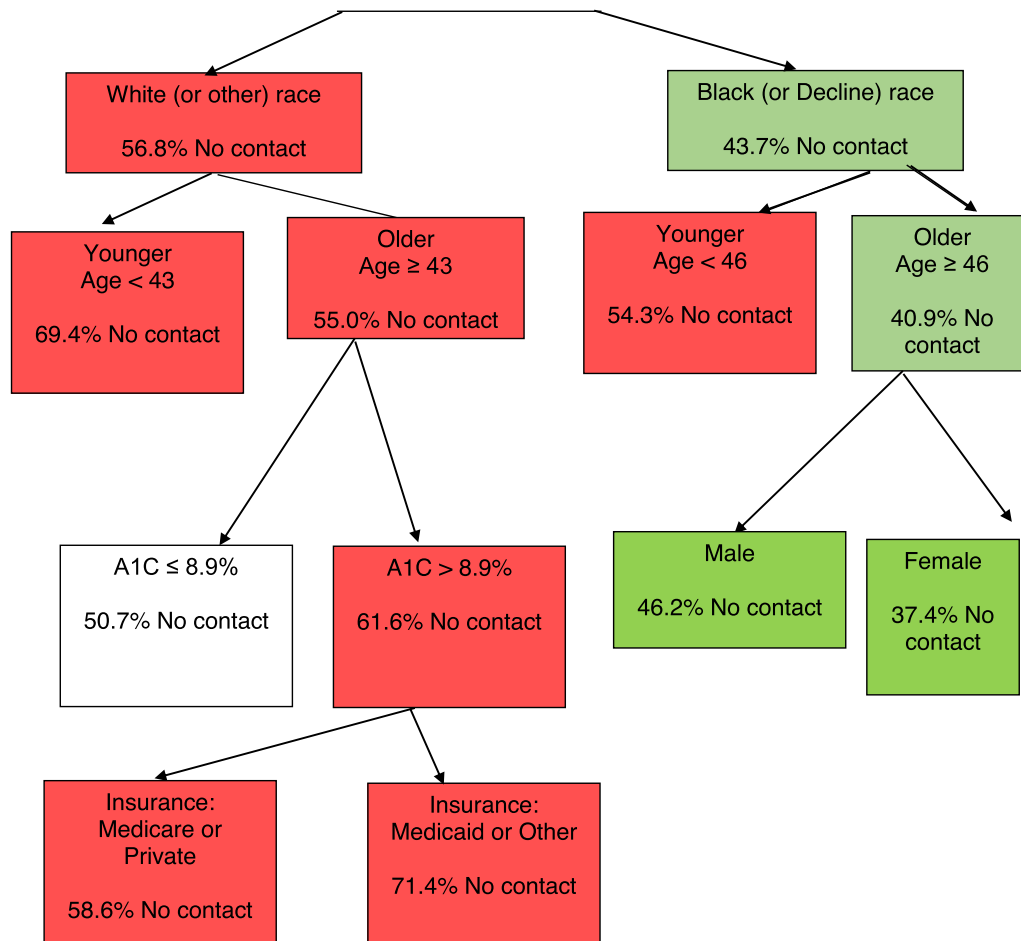


Fig. 1. All people (N = 3769), Decision tree for those who were successfully contacted to schedule an intake appointment (“Successfully contacted”).

**Table 4**  
Among people who scheduled DSMES intake appointment, comparing those who completed DSMES program vs those who did not attend intake appointment (“No Shows”).

Covariate	Statistics	Level	DSMES Completion Status		P-value <sup>a</sup>
			Completed DSMES Program N = 497	“No Shows” N = 588	
Age at referral	N (%)	Under 40	18 (3.6%)	77 (13.1%)	<0.05
	N (%)	40-<50	53 (10.7%)	102 (17.3%)	
	N (%)	50-<60	127 (25.7%)	169 (28.7%)	
	N (%)	60-<70	182 (36.8%)	146 (24.8%)	
Gender	N (%)	70 and up	115 (23.2%)	94 (16%)	<0.05
	N (%)	Female	264 (53.1%)	352 (59.9%)	
Race	N (%)	Male	233 (46.9%)	236 (40.1%)	<0.05
	N (%)	Black	242 (48.7%)	351 (59.7%)	
	N (%)	Decline/Unknown	38 (7.6%)	39 (6.6%)	
	N (%)	Other	17 (3.4%)	35 (6%)	
Marital status	N (%)	White	200 (40.2%)	163 (27.7%)	<0.05
	N (%)	Not partnered	208 (42.4%)	321 (56%)	
Insurance	N (%)	Partnered	283 (57.6%)	252 (44%)	<0.05
	N (%)	Medicaid	37 (7.4%)	143 (24.3%)	
	N (%)	Medicare	164 (33%)	114 (19.4%)	
	N (%)	Other/unknown	7 (1.4%)	13 (2.2%)	
Ever any tobacco products	N (%)	Private	289 (58.1%)	318 (54.1%)	0.527
	N (%)	No	305 (63.7%)	354 (61.8%)	
Age at referral	N (%)	Yes	174 (36.3%)	219 (38.2%)	<0.05
	Mean (SD)		495	588	
Had at least 1 A1C measure in two years prior to referral date	N (%)	No	24 (4.8%)	33 (5.6%)	0.564
	N (%)	Yes	473 (95.2%)	555 (94.4%)	
A1C value prior to referral date (in %)	N		473	555	<0.05
	Median		7.3	7.8	
	25th percentile		6.6	6.7	
BMI prior to referral date	75th percentile		8.7	10.7	0.585
	N		481	569	
	Mean (SD)		35.3 (7.6)	35 (8.3)	

BMI, body mass index DSMES, diabetes self-management education and support, SD, standard deviation.

<sup>a</sup> The parametric p-value is calculated by analysis of variance for numerical covariates, except A1C where values were non-normally distributed, so a Wilcoxon rank sum test was performed, and chi-square test for categorical covariates.

contacted” in the sample was 49.6%. The most important variable found to predict who was successfully contacted was race and that is seen as the first split in the decision tree of Fig. 1. The data showed that the White plus other race group (this is primarily White race so will be referred to as White for simplicity) had a higher rate of “not successfully contacted” at 56.8% as compared with the Black plus “Declined race

group” (will be referred to as Black for simplicity) of which 43.7% were “not successfully contacted.” We found that White people older than 43 years, with a prior A1C value > 8.9 and with Medicaid/Other insurance had the highest “not successfully contacted” rate of 71.4%. Conversely, the subgroup of Black females of age ≥ 46 years had the lowest “not successfully contacted” rate of 37.4%. Smoking, partnered status, and prior BMI did not influence the contact rates.

Of the 1901 participants that were contacted by staff, 476 completed their DSMES plan; 588 did not appear at their scheduled intake appointment (“No Show”), and 816 started but did not complete their DSMES program plan (“Incomplete” [42.9%]). The goal of the DSMES program is to have all contacted individuals make and attend an intake appointment where they will develop a DSMES program plan, which they should complete; therefore, the subsequent research questions, addressed these steps.

### 3.2. What are the demographic characteristics of the successfully contacted people that make a DSMES intake appointment but never attend the intake appointment?

Table 4 shows the basic comparison of the 497 people who attended their intake appointment and developed a DSMES plan vs the 588 people who did not attend their intake appointment (referred to as “No Show” group). The “No Show” group tended to be younger (mean age 56 vs 62 years), were slightly more likely to be female, of Black race and not partnered. Members of the “No Show” group were more likely to have Medicaid and less likely to have Medicare. There was no difference in mean BMI between the two groups nor was either group more or less likely to have a prior A1C value available via the EMR. For those with a prior A1C value, the “No Show” group tended to have higher prior A1C value (median of 7.8% as compared with a median of 7.3% in those who fully completed the program).

Fig. 2 shows the results from the CART analysis in which the important factors for being a “No Show” are identified when compared with individuals who completed their DSMES appointment. The same limited set of variables was used: age, gender, race, insurance, marital status, BMI and A1C. The variables that were importantly related to the “No Show” rate are insurance, age, gender and prior A1C value as depicted in Fig. 2. Those with insurance of Medicaid or Other had the highest “No Show” rate at 78% as compared with 48.8% of those with other insurance (Private or Medicare). Among those who had Private/Medicare insurance, age was again an important factor with those of younger age (<48 years) having a higher “No Show” rate at 73.7% compared with older people (44.5%). Within the private/Medicare insurance group, there was a further split after age – when age was at least 48 years, the prior A1C value mattered. More specifically, when the person’s A1C was at least 8.1%, they were slightly more likely to be a “No Show” (54.4%). The lowest “No Show” rate occurred among those with Medicare or private insurance and those who were at least 48 years of age and whose A1C was < 8.1% (39.5%). Conversely, within the Medicare/private insurance group, those of Black race younger than 48 years had a high “No Show” rate (81.3%).

### 3.3. What are the demographic characteristics of the people that complete at least one but not all DSMES sessions in their personalized plan (“Incomplete”) as compared with those who complete all sessions?

Table 5 shows the comparison of the 497 people who fully completed the DSMES program vs the 816 who did not complete all sessions after attending their intake appointment to make a personalized DSMES plan. The “Incomplete” group tended to be younger (mean age 57 vs 62 years), were slightly more likely to be female, of Black race and not partnered. The insurance of the “Incomplete” group was more likely to be Medicaid and less likely to be Medicare. There was no difference in mean BMI between the two groups nor was either group more or less likely to have a prior A1C value available in the EMR. For those with a prior A1C value, the “Incomplete” group tended to have a higher prior A1C value with a median of 7.8% as compared with a median of 7.3% in

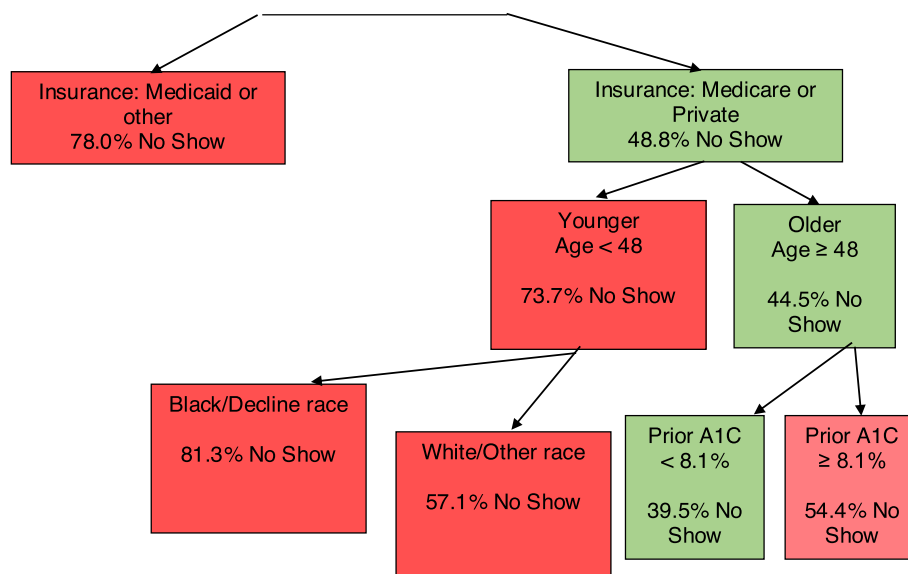


Fig. 2. Decision tree for those who did not complete their intake appointment (“No Show”).

the “Completers” group.

Fig. 3 shows the results from the CART analysis, comparing those who did not complete their DSMES plan (“Incomplete”) with those who completed their DSMES plan (“Completers”), using the same limited set of variables: age, gender, race, insurance, marital status, BMI and A1C. Age, gender and prior A1C level were most importantly related to being in the “Incomplete” group. People aged at least 62 years had a lower incompleteness rate with 51.1% as compared with 70.7% in people younger than 62 years. The completion rate was even lower among those younger than 47 years (82.3%). Older males with a lower prior A1C ( $\leq 8.3\%$ ) had the lowest incompleteness rate (34.0%). Among those of older age, the subgroup that may benefit the most from a DSMES program changes focused on increasing completing DSMES plans would be those people with higher A1C values ( $> 8.3\%$ ; incompleteness rate of 63.4%).

#### 4. Discussion

In these analyses, we used variables available in the EMR to identify subgroup characteristics of people at various stages of engagement in DSMES. Findings showing that almost half of those referred were not successfully contacted along with the overall low completion rate of 13.2% confirm the need to examine factors predictive of participation and completion. Overall, these results highlight several opportunities to improve patient engagement across demographic groups.

These analyses identified younger males with Medicaid insurance, likely a proxy for low income, as comprising the greatest proportion of those who were not successfully contacted and of those who did not show for intake appointments. This is not surprising as we know that younger people with diabetes often face multiple life-stage stressors such as furthering their education, working, caring for a child and maintaining stable housing, which can be at odds with optimal diabetes care (McCoy et al., 2019). Black women over the age of 46 years in this analysis had the highest rate contact (62.6%). The higher “No Show” rates among people with higher A1c values deserves further study of possible causes such as burden of treatment, level of confidence/self-

efficacy for management behaviors and the level of social and family support. Similarly higher “No Show” rates among those with Medicaid insurance may reflect the added challenges of lower socioeconomic status. These results are consistent with other studies (Adjei Boakye et al., 2018; Lee, 2020) that found that non-Hispanic black respondents, compared with non-Hispanic white respondents, were more likely to report engaging in DSMES while men and respondents younger than 65 years of age were less likely to engage in DSMES. Respondents with health insurance and respondents who used insulin were significantly more likely to engage in DSMES as were those whose annual household income was  $\geq \$50,000$ . Our study examined trends in patient engagement after referral including being successfully contacted by staff, attending an intake appointment and participation in DSMES classes. While we could have made additional comparisons between subgroups at various stages of the DSMES process, we chose *a priori* to focus on these 3 steps in the completion process.

Based on our findings in this analysis, we have implemented several changes in DSMES program engagement and retention efforts, using a quality improvement approach to monitor impact. We routinely screen for social needs, enact service recovery procedures for those who miss scheduled sessions, and offer more individual education sessions to complete the DSMES plan. Consensus reports (Powers et al., 2020) recommend creative technology-based solutions to increase reach and engagement, such as telehealth, EMRs, mobile applications, and cognitive computing to proactively identify and track people, combined with individualized and contextualized services. Thus, we have now added secure text messaging by the DSMES staff and have increased communication through the EMR patient portal. We are also incorporating feedback from our recently convened patient advisory panel on the design of outreach and educational materials to ensure they are patient centered, culturally appropriate and meet health literacy standards. Aligned with American Diabetes Association’s (ADA) recommendations to identify and address health system, payor, provider, and patient level barriers to diabetes self-management education and support, our health system has given DSMES staff access to a standardized 15-question social determinants of health screening tool in our EMR that assesses barriers

**Table 5**  
Comparing people who attended at least 1 but not all DSMES session (“Incomplete”) with those that completed all sessions.

Covariate	Statistics	Level	DSMES Completion Status		P-value <sup>a</sup>
			Completed DSMES Program N = 497	“Incomplete” N = 816	
Age at referral	N (%)	Under 40	18 (3.6%)	84 (10.3%)	<0.05
	N (%)	40-<50	53 (10.7%)	146 (17.9%)	
	N (%)	50-<60	127 (25.7%)	255 (31.3%)	
	N (%)	60-<70	182 (36.8%)	200 (24.5%)	
	N (%)	70 and up	115 (23.2%)	131 (16.1%)	
Gender	N (%)	Female	264 (53.1%)	501 (61.4%)	<0.05
	N (%)	Male	233 (46.9%)	315 (38.6%)	
Race	N (%)	Black	242 (48.7%)	455 (55.8%)	<0.05
	N (%)	Decline/Unknown	38 (7.6%)	53 (6.5%)	
	N (%)	Other	17 (3.4%)	47 (5.8%)	
	N (%)	White	200 (40.2%)	261 (32%)	
Marital status	N (%)	Not partnered	208 (42.4%)	408 (51.1%)	<0.05
	N (%)	Partnered	283 (57.6%)	391 (48.9%)	
Insurance	N (%)	Medicaid	37 (7.4%)	147 (18%)	<0.05
	N (%)	Medicare	164 (33%)	183 (22.4%)	
	N (%)	Other/unknown	7 (1.4%)	17 (2.1%)	
Ever used any tobacco products	N (%)	Private	289 (58.1%)	469 (57.5%)	0.37
	N (%)	No	305 (63.7%)	533 (66.1%)	
	N (%)	Yes	174 (36.3%)	273 (33.9%)	
Age at referral	N		495	816	<0.05
	Mean (SD)		61.9 (11.2)	56.7 (13.1)	
Had at least 1 A1C measure in 2 years prior to referral date	N (%)	No	24 (4.8%)	40 (4.9%)	0.95
	N (%)	Yes	473 (95.2%)	776 (95.1%)	
A1C value prior to referral date (in %)	N		473	776	<0.05
	Median		7.3	7.8	
	25th percentile		6.6	6.6	
	75th percentile		8.7	9.9	
BMI prior to referral date	N		481	796	0.80
	Mean (SD)		35.3 (7.6)	35.2 (8)	

BMI, body mass index; DSMES, diabetes self-management education and support; SD, standard deviation.

<sup>a</sup> The parametric p-value is calculated by analysis of variance for numerical covariates, except A1C where values were non-normally distributed, so a Wilcoxon rank sum test was performed, and chi-square test for categorical covariates.

including, but not limited to, transportation, finances, and food insecurity. The DSMES staff have been trained to administer this tool to people with an empathic inquiry approach. People who indicate a need are then referred to ambulatory case managers to connect them with appropriate health system and community resources such as rides to appointments and local food banks. We continue to track both the social determinants of health screening and referral rates for analysis of barriers to participation. Prior to our analyses, our DSMES staff initiated contact with patients by telephone within 2 business days of referral and then followed up those not reached with up to 2 additional telephone calls and a letter within 7 days of the last attempt. If patients

initiated their individualized goal plan, then subsequently missed an appointment, the recovery team attempted to contact them beginning on the day of the missed appointment. They made 3 recovery attempts – 2 via telephone and 1 via United States Postal Service. If the DSMES staff were unsuccessful, the patient was then considered lost to follow-up. We have changed work processes so that people with diabetes who disengage in the process at any stage, are more quickly identified via standardized reports and successfully contacted to “rescue” their participation. We are also collecting information from those who decline participation or who disengage to understand the primary reasons for their choices. Due to COVID-19 pandemic precautions, group sessions were converted to individualized sessions conducted via telephone and internet meetings in which facilitators engage patients in shared decision-making and use conversational maps for developing an individualized goal plan which is reviewed and assessed at every visit.

**5. Conclusion**

These results exemplify the importance of ADA recommendations to identify and address barriers affecting participation with DSMES services following referral. CART analysis has shown that those who were older, White race, Medicaid insured, and with higher A1C values had the lowest rates of being successfully contacted for their intake appointment. Older males with a lower A1C (<8.3%) had the highest rates of completing their DSMES plan. The data showed that almost half of those referred were not successfully contacted. The overall low rates of successful contact and completion confirms the need to examine predictive factors and to develop more innovative patient centered outreach. Future work may include focus groups to better understand patient preferences, barriers and experiences of diabetes distress and to obtain their feedback on patient-centered education methods such as empowerment-based self-discovery learning (Funnell, 2016). We may also explore implementing peer support programs to increase DSMES participation (Fisher et al., 2015). The ongoing evolution of our patient engagement process is based on best practices, feedback from our people, and careful analysis of trends in utilization as we work to ensure that the right people are connected to the right program at the right time.

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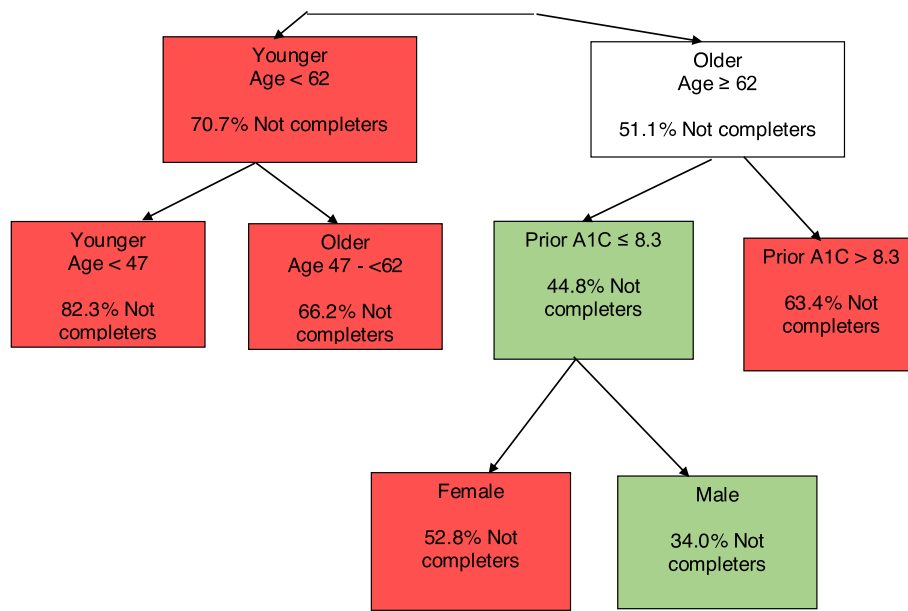
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**CRedit authorship contribution statement**

**Denise White Perkins:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Pam Milan:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing. **Kimberly Miazek:** Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – review & editing. **Suzanne Havstad:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Ganesa Wegienka:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



**Fig. 3.** Decision tree for those who completed at least one but not all DSMES Session (“Incomplete”). Abbreviations: DSMES, diabetes self-management education and support.

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