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COST-EFFECTIVENESS OF TELEPHONE-DELIVERED EDUCATION AND BEHAVIORAL SKILLS INTERVENTION FOR AFRICAN AMERICAN ADULTS WITH DIABETES

Leonard E. Egede, MD, MS[1,2]; Clara E. Dismuke, PhD[3];
Christian Eiler, MS[1]; Joni S. Williams, MD, MPH[1,2];
Rebekah J. Walker, PhD[1,2]

Purpose: Evaluate cost-effectiveness of a telephone-delivered education and behavioral skills intervention in reducing glycemic control (HbA1c) and decreasing risk of complications.

Methods: Data from a randomized controlled trial, conducted from August 1, 2008 – June 30, 2010 and using a 2x2 factorial design delivered to 255 African American adults not meeting glycemic targets for diabetes were used. Though the primary aim found no significant differences in HbA1c between groups, there was an overall drop in HbA1c across arms and differential cost. Primary clinical outcome was HbA1c measured at 12-months. Costs were estimated based on self-reported utilization of primary care, emergency, and other health care. Costs due to lost wages were calculated based on self-reported days of work missed due to illness. The Michigan Model for Diabetes was used to estimate 10-year probability of developing congestive heart failure, cardiovascular disease, end stage renal disease, stroke, myocardial infarction, all cause death, and CVD death. Total cost per patient and clinical outcomes were used to estimate an incremental cost effectiveness ratio (ICER) using non-parametric bootstrapping.

Results: ICERs indicated combined education and skills intervention was $3,630 less expensive than usual care to achieve a 0.6% decrease in HbA1c and was between $34,000 and $95,000 less expensive than usual care to reduce risk of complications. The knowledge only intervention was $661 less expensive than usual care and the behavioral skills only intervention did not indicate cost effectiveness.

Conclusion: The combined intervention ICER for HbA1c is comparable to other education programs and the ICER to reduce the probability of complications falls below previously recommended long-term cut-off of $100,000, suggesting cost-effectiveness in an African American population. *Ethn Dis.* 2021;31(2):217-226; doi:10.18865/ed.31.2.217

Keywords: Cost-Effectiveness; Diabetes; Education; Skills, African American; Telephone

INTRODUCTION

As the seventh leading cause of death, diabetes is a major public health problem contributing to a high disease burden for millions of Americans and a high economic burden for both individuals and health care systems.[1] Among individuals in the United States aged 18 and older, approximately 10% are diagnosed with diabetes and another 2.8% have undiagnosed diabetes, placing them at increased risk for complications such as heart disease and stroke, blindness, kidney disease, and lower-extremity amputations.[1,2] Recent estimates show total costs for diagnosed diabetes to be $327 billion, accounting for $237 billion in direct medical costs and $90 billion in lost productivity.[3] Compared with non-Hispanic Whites, African Americans have a higher prevalence of diagnosed diabetes, are less likely to reach glycemic targets, and are at a greater risk for complications and death.[1,4] While the reasons for these differences have not been clearly elucidated, evidence suggests patient, provider, and health systems factors contribute to this disparity, with most of the effect resulting from patient level factors such as diabetes knowledge, self-management skills, empowerment, and perceived control.[5,6]

Diabetes self-management education (DSME) is considered the cornerstone of clinical diabetes management.[7-10] Evidence suggests DSME is important to optimize

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[1] Division of General Internal Medicine, Department of Medicine, Medical College of Wisconsin, Milwaukee, WI

[2] Center for Advancing Population Science, Medical College of Wisconsin, Milwaukee, WI

[3] Health Economics Resource Center (HERC), VA Palo Alto Health Care System, Palo Alto, CA

Address correspondence to Leonard E. Egede, MD, MS, Medical College of Wisconsin, Division of General Internal Medicine, 8701 Watertown Plank Rd., Milwaukee, WI 53226-3596; legede@mcw.edu

glycemic levels, improve clinical and behavioral outcomes, prevent adverse complications, heighten quality of life, and minimize costs associated with diabetes care.[7-9] As a result, a joint position statement from the American Diabetes Association, the American Association of Diabetes Educators, and the Academy of Nutrition and Dietetics recommend all individuals with diabetes receive DSME at diagnosis and as needed thereafter.[10] Prior research has shown telephone-based interventions improve clinical outcomes including glycemic, blood pressure, and lipid levels.[11] In addition, behavioral programs are particularly beneficial to individuals not meeting glycemic targets.[12] Despite promising results, the implementation of these interventions in African American populations has been limited.[13] A study designed to test the efficacy of separate and combined telephone-delivered, diabetes knowledge/information and motivation/behavioral skills training intervention in African Americans not meeting glycemic targets for type 2 diabetes found that hemoglobin A1c (HbA1c) at 12 months for the combined education and skills group did not differ significantly from the education only group, the skills training only group, or usual care.[13] There was, however, a significant decline in HbA1c over time for all groups.[13]

> *The objective of this study was to evaluate the cost-effectiveness of a telephone-delivered education and behavioral skills intervention in reducing HbA1c and decreasing risk of complications.*

Though DSME is a core aspect of high-quality diabetes care, a study conducted across 27 countries found fewer than 50% of respondents report participating in DSME.[14] In addition, though 58% of adults with diabetes report having attended a diabetes class, two studies conducted in the United States found adults with newly diagnosed diabetes had extremely low rates.[15] Fewer than 7% of newly diagnosed patients with private insurance received DSME based on claims data within 1 year after diagnosis, and approximately 5% of Medicare beneficiaries with newly diagnosed diabetes received DSME.[16,17] In general, diabetes education programs report an overall cost benefit, though cost savings for education programs have been modest.[18,19] A study using claims data found that participants in education programs had less rapid increase in costs; however, the overall difference with individuals who did not complete education was between \$100-\$200.[20] An economic analysis conducted in 2000 found savings ranging from \$0.44 to \$8.76 for every \$1 spend on education.[21] In addition, a systematic review of the clinical and cost effectiveness of educational interventions with a minimum of 12-month follow-up for individuals with diabetes found an overall cost benefit of \$600-\$800.[22] Reporting of methodology was poor, however, and the authors noted a general lack of information on cost-effectiveness and very few studies that evaluated quality of life.[23] More recent studies have conducted cost-effectiveness analyses, rather than focusing only on cost savings, and found incremental cost effectiveness ratios (ICERs) in the range of \$500-\$26,000.[24-26] However, while costs of prior education programs are helpful to gauge possible savings, implementation of diabetes self-management and education programs varies widely, making comparison between programs difficult.[26] Additionally, to our knowledge no cost-effectiveness analyses for diabetes education have focused on minority populations.

The objective of this study was to evaluate the cost-effectiveness of a telephone-delivered education and behavioral skills intervention in reducing HbA1c and decreasing risk of complications. Data from a randomized controlled trial using a 2x2 factorial design delivered to 255 African American adults not meeting glycemic targets for diabetes were used. These results will help inform reimbursement for education and skills training programs delivered via telephone targeted to minority populations with higher burden of disease.

METHODS

Study Design and Participants

This study was based on a randomized controlled trial conducted from August 1, 2008 – June 30, 2010, which examined the effectiveness of telephone delivered behavioral skills and diabetes education in improving glycemic control. Details of the protocol and primary outcomes for the trial have been documented elsewhere and are briefly described below.[13,27] All procedures were in accordance with the ethical standards of the Institutional Review Board and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all participants included in the study. Participants were non-Hispanic Black adults (aged ≥ 18 years) who were not meeting glycemic targets for type 2 diabetes (HbA1c ≥ 9.0%). Inclusion criteria were: a diagnosis of diabetes; a working landline; the ability to speak English; taking at least one oral medication for hypertension or hyperlipidemia; and the willingness to use an electronic compliance monitor (eCAP). Exclusion criteria included: mental confusion examined at initial interview; participation in other diabetes trials; presence of alcohol abuse/dependence; pregnancy or lactation; or a life-expectancy of less than 6 months. Two-hundred and fifty-five (255) patients were randomized to one of four study arms.

Study Setting and Randomization

For this 2x2 factorial randomized controlled trial, patients were recruited from general medicine, endocrine, family medicine, and community primary care clinics at an academic medical center, or from a Veterans Administration Medical Center in the southeastern United States. Participants were randomized into one of the four study arms: 1) telephone-delivered diabetes knowledge/information, (ie, diabetes knowledge only group); 2) telephone-delivered motivation/behavioral skills training (ie, skills training only group); 3) combined telephone-delivered diabetes knowledge/information and motivational/behavioral skills training (ie, combined knowledge and skills training group); or 4) control group (usual standard of care plus general health education). Randomization was 1:1 and was web-based and computer generated. Follow-up visits occurred at 3, 6, and 12 months. To prevent bias in the evaluation of outcomes, research staff were blinded to treatment assignment.

Intervention Description

The 12-week diabetes self-management education and support (DSMES) intervention[13,27] was based on American Diabetes Association guidelines. All weekly intervention calls were delivered by masters-level health educators who were trained in the basic elements of behavioral skills and on intervention delivery prior to initiation of the study. Each call lasted approximately 30 minutes. The telephone-delivered diabetes knowledge group received diabetes knowledge/information only. The telephone-delivered skills training group received a motivation/behavioral skills intervention consisting of patient activation (a list of 5 questions to ask providers at every visit and training on how to ask the questions), patient empowerment (diabetes responsibility contracts, personal goals, and flow charts for recording lab results/medications and training on how to use the empowerment tools), and behavioral skills training that focused on four behaviors: blood glucose monitoring, medication taking behavior, diet, and physical activity. The combined telephone-delivered diabetes knowledge and skills group received both diabetes knowledge/information, and motivational/behavioral skills training. The usual care group received weekly telephone-delivered general health education lasting 30 minutes for 12 weeks to control for attention.

Clinical Outcome

The primary clinical outcome was glycemic control (HbA1c) measured four times (at baseline, 3-month follow up, 6-month follow up, and 12-month follow up). It has been previously documented that while changes within each arm were clinically meaningful, the treatment arms did not significantly improve HbA1c compared with the usual care group at the 12-month follow up.[13]

Health Care Cost and Lost Wages

A societal perspective was used to calculate health care system and patient level costs. As the intervention was the same cost across the four arms, it was not incorporated into the comparison. All costs were adjusted for inflation to 2017 dollar

Table 1. Demographics by treatment group[a]

	All, N = 255	Usual care, n=64	Knowledge, n=63	Behavioral skills, n=65	Combined, n=63	P
Age	57.3 (10.3)	56.1 (10.3)	56.5 (11.5)	58.3 (9.5)	58.2 (10.0)	.51
Years of education	13.0 (2.8)	12.9 (2.8)	12.9 (2.7)	12.7 (2.3)	13.3 (3.1)	.59
Duration of diabetes	13.2 (9.0)	13.5 (9.3)	12.5 (8.3)	13.5 (8.8)	13.7 (9.7)	.87
Sex						
Men	55.3	51.6	55.6	61.5	52.4	.66
Marital status						
Married	43.1	43.7	41.3	46.1	41.3	.93
Income						.01
<$10,000	24.3	23.4	28.6	18.4	27.0	
$10,000 - $20,000	25.9	15.6	22.2	32.3	33.3	
$20,001 - $35,000	29.0	37.5	36.5	30.8	11.1	
>$35,000	20.8	23.5	12.7	18.5	28.6	
Employment						.32
Full/part-time	33.4	39.1	36.5	30.8	27	
Retired	23.9	18.8	15.9	24.6	36.5	
Disabled	32.9	34.4	36.5	35.4	25.4	
Unemployed	9.8	7.8	11.1	9.2	11.1	
Insurance						.26
Private	19.6	23.4	23.8	16.9	14.3	
Government	62.3	59.4	60.3	64.6	65.1	
None	6.7	1.6	6.4	12.3	6.3	
Dual	11.4	15.6	9.5	6.2	14.3	
BMI						.60
<25	9.5	6.2	12.9	7.7	11.1	
<30	17.7	17.2	14.5	15.4	23.8	
30+	72.8	76.6	72.6	76.9	65.1	
Number of comorbidities						.03
0/1	16.9	9.4	26.9	13.9	17.5	
2	36.8	42.2	42.9	33.8	28.6	
3+	46.3	48.4	30.2	53.3	53.9	

a. Continuous variables reported as mean (standard deviation).

values using the US Department of Labor Inflation Calculator (CPI inflator) (https://www.bls.gov/data/inflation_calculator.htm). Individuals reported utilization of primary care, ER visits, and inpatient hospital stays over the prior 12 months as part of their follow-up survey. In order to convert the number of visits reported by participants into cost, we used mean expenditures for primary care, ER, and inpatient estimated from the nationally representative Medical Expenditure Panel Survey (MEPS). The number of each type of visit reported by participants was multiplied by the mean expenditure for that type of utilization from MEPS. This resulted in an estimated cost of health care for each individual in the study. Lost wages were calculated based on self-reported days of work missed due to illness and the wage of each individual. Wages were collected from individuals using dollar value intervals in the baseline survey, so to estimate lost wages due to illness, an interval regression was used. The interval models were adjusted for patient age, gender, educational level, and self-reported health status. Mean estimated wages were then divided by 260 and multiplied by self-reported lost days of work due to illness. For those with no employment or who answered 0 days of work missed due to illness, lost wages were considered $0.

Complications of Diabetes

Complications of diabetes are both detrimental to quality of life and account for the majority of long term

Table 2. Changes in clinical outcome (HbA1c) and cost by treatment group[a]

	Usual care	Knowledge	Behavioral skills	Combined	P
HbA1c					
Baseline	9.47 (2.48)	9.27 (1.80)	9.24 (2.09)	9.15 (1.89)	.86
12 months	8.36 (1.71)	8.78 (2.05)	8.45 (1.90)	8.48 (1.68)	.70
Mean change in HbA1c	-.85 (1.978)	-.51 (1.639)	-.59 (1.863)	-.46 (1.77)	.71
Utilization Costs					.44
Primary care	$930.97 (949.42)	$686.81 (868.15)	$737.72 (820.49)	$718.86 (547.74)	
Other health care	$3,974.69 (6,961.78)	$3,455.19 (8,885.83)	$4,742.66 (7,231.23)	$6,053.32 (9,791.00)	
ER visits	$481.94 (821.36)	$498.00 (752.91)	$551.63 (898.31)	$458.48 (776.16)	
Workdays missed	$430.07 (1,448.21)	$210.24 (838.31)	$231.53 (647.26)	$342.78 (784.21)	
Total costs	$5,817.66 (8,293.69)	$4,850.24 (10,086.53)	$6,263.51 (7,738.95)	$7,573.43 (10,474.66)	

a. Reported as mean (standard deviation)

costs for managing diabetes.[19] Therefore, we used the Michigan Model for Diabetes (MMD) to estimate the 10-year probability of developing congestive heart failure (CHF), cardiovascular disease (CVD), end stage renal disease (ESRD), stroke, myocardial infarction (MI), death, and death due to CVD. MMD uses a Markov Model to simulate the progression of diabetes-related outcomes as a function of patient level characteristics, current status of disease, and current status of treatment.[28,29]

Statistical Analysis

Participants were included in the analysis based on protocol. There were two outliers in the control group that reported high illness days beyond three standard deviations and were dropped from the sample. Similar methodology to Pyne et al was used; however, a series of outcomes were used as the main outcome for effectiveness rather than quality-adjusted life year (QALYs).[30] First, general demographics of the four arms of the study were calculated using frequencies and means and compared using χ^2 and t-tests. Second, mean change in HbA1c was compared across the 4 arms of the study using a t-test. Third, the total cost per patient and clinical outcomes were used to estimate an incremental cost effectiveness ratio (ICER) and bootstrapped in pairs using a non-parametric bootstrapping method with replacement repeating 1,000 times to provide confidence intervals. Cost effectiveness acceptability curves for each treatment arm were estimated as well. Effectiveness was measured as HbA1c, probability of CHF, probability of CVD, probability of ESRD, probability of MI, probability of death, and probability of death due to CVD. All analyses were completed using Stata/SE 15 and R, with significance considered at P<.05 (Stata Corp, 2017) (R Core Team, 2017).

RESULTS

Table 1 provides a summary of the sample demographics. The mean age for the full sample was 57.3, evenly split between men and women, with an average number of years of education of 13, and average duration of diabetes of 13 years. No significant differences were seen across the four arms, except for income and comorbidities. Differences existed between the usual care and the combined groups for both middle income categories, between the usual care and knowledge groups for 0/1 comorbidities and between the knowledge and combined groups for 3+ comorbidities.

Table 2 provides a summary of the clinical outcomes and costs by treatment group. Change in glycemic control ranged from a decrease of .46% HbA1c to a decrease of .85% HbA1c. The total costs per groups ranged from $4,850 to $7,573, however there was no significant cost difference between the groups (P = .44).

Table 3 provides as summary of the results of the MMD. The MMD simulation results showed no significant differences between groups at either baseline or 12-month follow up.

Table 4 provides results for mean

Table 3. Probability of outcomes as calculated by the Michigan Model for Diabetes by arm[a]

	Usual care	Knowledge	Behavioral skills	Combined	P
CHF					
Baseline	12.69% (13.92)	13.34% (16.02)	11.11% (13.36)	10.11% (10.23)	.50
12 months	19.19% (21.62)	14.88% (16.53)	13.05% (14.28)	13.56% (13.61)	.26
Mean change in CHF	6.72 (18.37)	1.53 (6.52)	1.94 (7.62)	3.44 (10.10)	.14
ESRD					
Baseline	2.61% (2.54)	2.00% (2.40)	2.03% (1.98)	2.33% (2.51)	.54
12 months	3.34% (3.47)	4.33% (3.80)	3.69% (3.33)	3.79% (3.62)	.50
Mean change in ESRD	.81 (3.62)	2.33 (3.79)	1.66 (3.23)	1.46 (4.01)	.14
MI					
Baseline	4.08% (7.03)	2.48% (4.43)	3.71% (7.83)	4.22% (7.77)	.27
12 months	2.69% (5.72)	1.66% (2.92)	2.32% (4.19)	2.19% (6.79)	.52
Mean change in MI	-1.36 (6.33)	-.83 (3.97)	-1.38 (5.67)	-2.03 (6.89)	.66
Stroke					
Baseline	3.94% (5.37)	4.77% (9.41)	5.85% (10.32)	3.16% (4.85)	.23
12 months	4.86% (7.35)	4.42% (6.23)	6.97% (16.62)	3.52% (7.86)	.46
Mean change in stroke	.94 (4.93)	-.34 (5.83)	1.12 (9.18)	0.37 (4.55)	.54
CVD					
Baseline	21.24% (46.60)	7.67% (19.55)	14.57% (39.67)	20.84% (49.96)	.06
12 months	12.73% (36.46)	6.33% (18.98)	11.37% (30.21)	8.43% (33.31)	.52
Mean change in CVD	-7.95 (38.53)	-1.34 (13.48)	-3.20 (24.12)	-12.41 (45.34)	.19
CVD Death					
Baseline	8.42% (14.80)	5.45% (10.29)	11.23% (17.33)	7.70% (13.34)	.13
12 months	6.75% (13.34)	4.48% (9.64)	9.26% (14.51)	4.48 (10.48)	.11
Mean change in CVD death	-1.44 (7.20)	-.97 (4.70)	-1.97 (6.24)	-3.22 (9.17)	.34
Death					
Baseline	14.87% (16.18)	13.72% (13.48)	19.78% (19.10)	15.05% (16.61)	.20
12 months	15.09% (14.61)	14.72% (13.86)	20.80% (18.79)	13.68% (13.61)	.09
Mean change in death	.55 (8.51)	1.00 (10.81)	1.02 (12.81)	-1.37 (12.97)	.68

a. Baseline and 12 months reported as % (standard deviation).
CHF, congestive heart failure; ESRD, end-stage renal disease; MI, myocardial infarction; CVD, cardiovascular disease.

bootstrapped incremental cost effectiveness ratio (ICER) for a .6% decrease in HbA1c. Compared with usual care, the ICER was -$660 for the knowledge arm, -$814 for the behavioral skills arms, and -$3630 for the combined knowledge and behavioral skills arm. Based on cost-acceptability curves representing the probability of falling below cost-effectiveness ratio thresholds, only the combined arm was considered cost-effective for obtaining a .6% decrease in HbA1c. The mean bootstrapped ICER for a percentage point decrease in the 10-year probability of developing CHF ranged from -$539 to $5,976.49, ranged from $179 to $1,401 for CVD, ranged from $370 to $15,904 for MI, and ranged from -$8,795 to $564 for stroke.

DISCUSSION

This study provides a cost-effectiveness analysis for a 12-week telephone-delivered intervention for African Americans with diabetes. We found the combined education and skills intervention was $3,630 less expensive than usual care to achieve a clinically relevant decrease in HbA1c. In addition, the combined intervention ranged between $34,000 and $95,000 less expensive to reduce risk of a variety of complications. The knowledge only intervention was $661 less expensive than usual care and the behavioral skills only intervention was $814 less expensive, but these interventions did not indicate cost effectiveness. Standardized cost savings for a 1% change in HbA1c range from $1,000-$4,000 per person per year depending on their current HbA1c

Table 4. Incremental cost effectiveness ratios (ICER) by treatment arm for multiple outcomes

	Knowledge	Behavioral Skills	Combined
HbA1c	-$660 (1,916,261,401)	-$814 (4,056,569,221)	-$3,630 (3,193,768,929)
Congestive heart failure	-$539 (10,058.90)	-$80 (10,815.90)	$5,976.49 (12,874.54)
End stage renal disease	$7,894 (36,099.95)	$650 (25,133.66)	-$6,606 (30,281.33)
Myocardial infarction	$3,783 (24,726.11)	$370 (14,416.51)	$15,904 (16,098.00)
Stroke	$564 (11,747.53)	$408 (10,785.94)	-$8,795 (12,768.25)
Cardiovascular disease	$327 (10,742.42)	$179 (4,046.43)	$1,401 (4,585.68)
CVD death	-$382 (15,566.36)	$72 (8,220.90)	-$1,128 (10,674.58)
Death	-$1,249 (10,690.72)	$119 (7,354.95)	$1,301 (9,345.04)

All incremental cost effectiveness ratios in reference to control group, reported as mean (standard deviation).

and number of comorbidities, suggesting the incremental cost benefit for the combined intervention may be a cost-effective alternative to general education, particularly in a minority population.[30] In addition, given the impact of complications on quality of life, and the fact that costs due to diabetes complications accrue over a long time frame, these estimates would suggest long-term cost-effectiveness using the cutoff calculated by Nuckols et al of long-term ICERs being cost-effective for patients with diabetes if below $100,000.[31]

This study adds unique information to the existing literature on the cost-effectiveness of diabetes education program in that it focuses on a population known to have a high burden of disease, calculates cost-effectiveness using HbA1c, a number of complications, and death, and compares three types of telephone-delivered programs against usual care. Standardized cost savings for 1% change in HbA1c shows the importance of improving the ability to meet glycemic targets, particularly for individuals at the highest HbA1c levels and those with existing comorbidities.[30] For example, patients with diabetes and heart disease or hypertension and an HbA1c of 9%-10% who decrease 1% would save on average $1,130-$2,078 per year.[30] One challenge with considering costs for diabetes is that costs accrue over a long time period, most particularly as a result of the cost of complications, whereas investments are consistent over time.[27,32] For example, a systematic review of economic analyses on quality improvement programs aimed to improve HbA1c found incremental net costs of approximately $116 annually, but long-term ICERs ranged from $100,000-$115,000 per QALY.[33] Additionally, a systematic review of interventions to prevent and control diabetes identified <$100,000 per QALY as cost-effective.[34] Given this information, the results of this study suggest the telephone-delivered education and skills intervention would be a cost-effective alternative.

Based on similar telephone-delivered programs published in the literature, the combined intervention provides similar or more cost savings. A telephone-based diabetes self-management intervention found an ICER compared with provision of printed materials of $490 per 1% change in HbA1c and $2,716 to achieve HbA1c target in one year.[23] Similarly, a hospital-based telephone coaching program modelled over a 10-year timeframe found cost savings of $3,327 per participant, though no significant differences in quality of life or life expectancy.[24] Based on the systematic review of cost-effective diabetes interventions, it is comparable to other low intensity interventions which generally require regular health care visits, access to medications, and intensive lifestyle change.[34] Given the increasing use of technology for delivering interventions, this study provides cost-effectiveness information on a low-tech option, requiring only access to a phone line. Cost-effectiveness studies of more expensive options offering video should be conducted to understand if the possible added benefit of video is outweighed by the increased cost of this technology in improving outcomes.

Study Limitations

This study is strengthened by the factorial design of the initial trial providing comparison across four arms, and the focus on a particularly vulnerable population, African American adults with diabetes, to confirm cost-effectiveness. However, there are limitations. First, participants were required to have an HbA1c >9%, and as such cost-effectiveness may be specific to a population not meeting glycemic targets. An intervention targeted to an HbA1c range such as 9% where larger changes in HbA1c are possible, are more likely to be found to be cost-effective than those targeted to a HbA1c range that is closer to the normal. This is because smaller changes in the clinical outcome will cause the ICER to become much larger, approaching statistical infinity when there is a zero or near zero difference between the clinical outcome of the intervention and usual care group. For example, if participants had been required to have an HbA1c > 7%, it is very likely the ICER would be larger, and therefore less likely to be acceptable under cost-acceptability scenarios. Secondly, there were some differences in the four arms for income and comorbidities, which could influence magnitude of effect. We do not expect that these differences explain findings given they were inconsistent and longer-term outcomes developed through the MMD were not significantly different between the arms. However, future studies could consider stratifying randomization by these factors or investigating if there is a differential impact by demographic variables. Third, the phone intervention was delivered by health educators, so costs may differ based on who delivers the education and skills training program. Finally, the standard deviations of ICERs are likely larger than would be expected. This is due to the small net effect prior to bootstrapping, as the number of replications increases the probability that large outliers will occur and impact the distribution.

> *We found the combined education and skills intervention was $3,630 less expensive than usual care to achieve a clinically relevant decrease in HbA1c.*

Conclusion

Given the importance of diabetes education and skills training to successful diabetes care, this study offers important information regarding the possible return on investment for a telephone delivered combined intervention for African Americans. The ICER for a telephone-delivered education program compared with general health education of $3,630 to achieve a clinically relevant decrease in HbA1c and is comparable to other education programs. In addition, the ICER to reduce the probability of complications for the combined intervention ranged between $34,000 and $95,000, which falls below the previously recommended long-term cut-off of $100,000. These results make a strong case for the importance of policies that increase access to and coverage of DSME services and programs, promote the use of telehealth platforms for DSME intervention delivery, and address patient level barriers in African Americans with type 2 diabetes to increase cost savings.

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Conflict of Interest

No conflicts of interest to report.

Author Contributions

Research concept and design: Egede, Dismuke, Williams, Walker; Acquisition of data: Egede, Williams, Walker; Data analysis and interpretation: Egede, Dismuke, Eiler, Williams, Walker; Manuscript draft: Egede, Dismuke, Eiler, Williams, Walker; Statistical expertise: Egede, Dismuke, Eiler, Walker; Acquisition of funding: Egede; Administrative: Egede, Williams, Walker; Supervision: Egede

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