Peer Mentoring and Financial Incentives to Improve Glucose Control in African American Veterans

A Randomized Trial

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Background: Compared with white persons, African Americans have a greater incidence of diabetes, decreased control, and higher rates of microvascular complications. A peer mentorship model could be a scalable approach to improving control in this population and reducing disparities in diabetic outcomes.

Objective: To determine whether peer mentors or financial incentives are superior to usual care in helping African American veterans decrease their hemoglobin A_{1c} (HbA_{1c}) levels.

Design: A 6-month randomized, controlled trial. (ClinicalTrials.gov registration number: NCT01125956)

Setting: Philadelphia Veterans Affairs Medical Center.

Patients: African American veterans aged 50 to 70 years with persistently poor diabetes control.

Intervention: 118 patients were randomly assigned to 1 of 3 groups: usual care, a peer mentoring group, and a financial incentives group. Usual care patients were notified of their starting HbA_{1c} level and recommended goals for HbA_{1c}. Those in the peer mentoring group were assigned a mentor who formerly had poor glycemic control but now had good control (HbA_{1c} level $\leq$7.5%). The mentor was asked to talk with the patient at least once per week. Peer mentors were matched by race, sex, and age. Patients in the financial incentive group could earn $100 by decreasing their HbA_{1c} level by 1% and $200 by decreasing it by 2% or to an HbA_{1c} level of 6.5%.

Measurements: Change in HbA_{1c} level at 6 months.

Results: Mentors and mentees talked the most in the first month (mean calls, 4; range, 0 to 30), but calls decreased to a mean of 2 calls (range, 0 to 10) by the sixth month. Levels of HbA_{1c} decreased from 9.9% to 9.8% in the control group, from 9.8% to 8.7% in the peer mentor group, and from 9.5% to 9.1% in the financial incentive group. Mean change in HbA_{1c} level from baseline to 6 months relative to control was −1.07% (95% CI, −1.84% to −0.31%) in the peer mentor group and −0.45% (CI, −1.23% to 0.32%) in the financial incentive group.

Limitation: The study included only veterans and lasted only 6 months.

Conclusion: Peer mentorship improved glucose control in a cohort of African American veterans with diabetes.

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Management of diabetes mellitus has proven difficult because many of the most critical elements of disease management occur outside of clinical encounters. Intensive, clinic-based programs have been effective in improving diabetes management, but such programs are resource-intensive and effectiveness decreases over time. Support from family and friends is often not a viable alternative because many patients are socially isolated, others may not want to engage relatives or friends in discussions of medical problems, and family and friends may be unable to assume a caretaker role (1).

Disease-specific social support has been shown to improve diabetes self-management behaviors and may be particularly beneficial when the support comes from a peer with the same chronic condition (2–6). In interventions with patients with diabetes, peer support has been shown to be effective in improving medication adherence; diet; exercise; blood glucose monitoring; and, most recently, glucose control (7–11). Prior interventions have introduced peer support through group visits, nurse telephone calls, or home visits from community health workers; however, these require expensive professional or semiprofessional support staff (12–18). A more informal, flexible means of providing one-on-one peer support through volunteer peer coaches or mentors could potentially provide similar benefits at lower cost.

Financial incentives could enhance diabetes self-care. These incentives show promise in domains of behavior, such as medication adherence (19), diet and exercise (20), and smoking (21), where people's short time horizons lead them to favor immediate benefits at the expense of delayed costs (22–24). To our knowledge, financial incentives as a way of improving diabetes control have not been tested.

To test the efficacy of these emerging means to promote health behaviors, we performed a randomized, controlled trial of peer mentoring and financial incentives aimed at improving glucose control in African American veterans with persistently poor control.

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METHODS

Design Overview

Patients were randomly assigned to 1 of 3 groups in parallel: usual care, peer mentoring, or financial incentives. Study investigators were blinded to the allocation and results until study completion. We used the Philadelphia Veterans Affairs (VA) Medical Center laboratory for all study-based blood sampling. Phlebotomists were unaware of the study. The study was completed with 1 unblinded research assistant. Informed consent was obtained from all participants with a different consent process for patients and mentors. The Philadelphia VA Medical Center institutional review board approved all aspects of the study. Enrollment occurred between October 2009 and April 2010; follow-up was completed by October 2010.

Setting and Patients

We identified patients treated at the Philadelphia VA Medical Center with at least 2 International Classification of Diseases, Ninth Revision, 250 codes and had at least 2 hemoglobin A_{1c} (HbA_{1c}) samples collected in the past 3 years. Inclusion criteria were age 50 to 70 years, self-identified race of black or African American, and persistently poor diabetes control. We chose to perform a single-race study to determine whether this intervention would be effective in an African American population as a potential approach to reducing disparities, given that this group is disproportionately adversely affected by diabetes, poor control, and complications from poor control (25–29). Persistently poor diabetes control was defined as having the past 2 HbA_{1c} levels in the electronic medical record above 8%, with the last measurement done within 3 months of enrollment. All patients also had an HbA_{1c} sample collected on the day of enrollment and at the end of 6 months. One person whose baseline HbA_{1c} level was below 7% was excluded from the study because of concerns that the intervention might lead to dangerous hypoglycemia. Potential patients were identified from the electronic medical record on an ongoing basis.

Of 642 charts of patients with diabetes that were reviewed, 366 did not meet eligibility (mostly because the patient was not African American or had not had a recent HbA_{1c} measurement). We were able to contact 192 (70%) of the 276 potential eligible patients, of whom 74 (39%) declined to participate, leaving us with 118 patients: 39 were assigned to the control group, 39 to the peer mentoring group (including the 1 person who was excluded because of low starting HbA_{1c} level), and 40 to the financial incentive group (**Figure 1**).

Randomization and Intervention

We created a file in Microsoft Office Excel 2007 (Microsoft, Redmond, Washington) with 40 allocations per group. Using the random-number generator function, we gave each group assignment a random number and put the ordered numbers in envelopes. The envelopes were sealed, shuffled, and stacked, and the research assistant took the top envelope after consent was obtained to determine group assignment. Neither blocking nor stratification was used in the process.

A short baseline survey was administered at the initial visit, for which patients were paid $25. All patients were called the day after enrollment and notified of their starting HbA_{1c} level as well as the American Diabetes Association and VA recommendations about HbA_{1c} target levels. All patients were paid $25 for returning 6 months later for the follow-up HbA_{1c} measurement. The control group received no further intervention. We did not influence provider clinical care. Reimbursements were provided in the form of a VA voucher, which the patients could redeem for cash.

Patients in the peer mentoring group were matched to a peer mentor within 1 to 3 weeks. Guided by our own qualitative research (30), peer mentors were all African American patients whose glucose control had previously been poor but was currently good (defined as an HbA_{1c} level $>8\%$ in the past 3 years and $\leq 7.5\%$ within 3 months of enrollment). Peer mentors were matched by sex and age (± 10 years). Active recruitment of mentors occurred only after a patient had been randomly assigned to the peer mentor group. Potential mentors were identified and recruited in a manner similar to that of patients. Of 72 eligible mentors contacted, 27 declined to participate and 7 did not show up for training. One potential mentor was excluded at the baseline visit because he was incoherent. The overall participation rate of those contacted was 51%. No mentors reported that they had been assigned to patients they knew.

Peer mentors participated in an hour-long, one-on-one training session informed by motivational interviewing

Context

Clinic-based interventions have been shown to help patients with diabetes improve glucose control but are expensive.

Contribution

A randomized, controlled trial compared 2 interventions, peer mentoring or a modest financial incentive, designed to help patients with poor diabetes control decrease their hemoglobin A_{1c} levels. Patients randomly assigned to the peer mentoring group achieved a statistically significant decrease of almost 1% in their hemoglobin A_{1c} level compared with those randomly assigned to the control group.

Caution

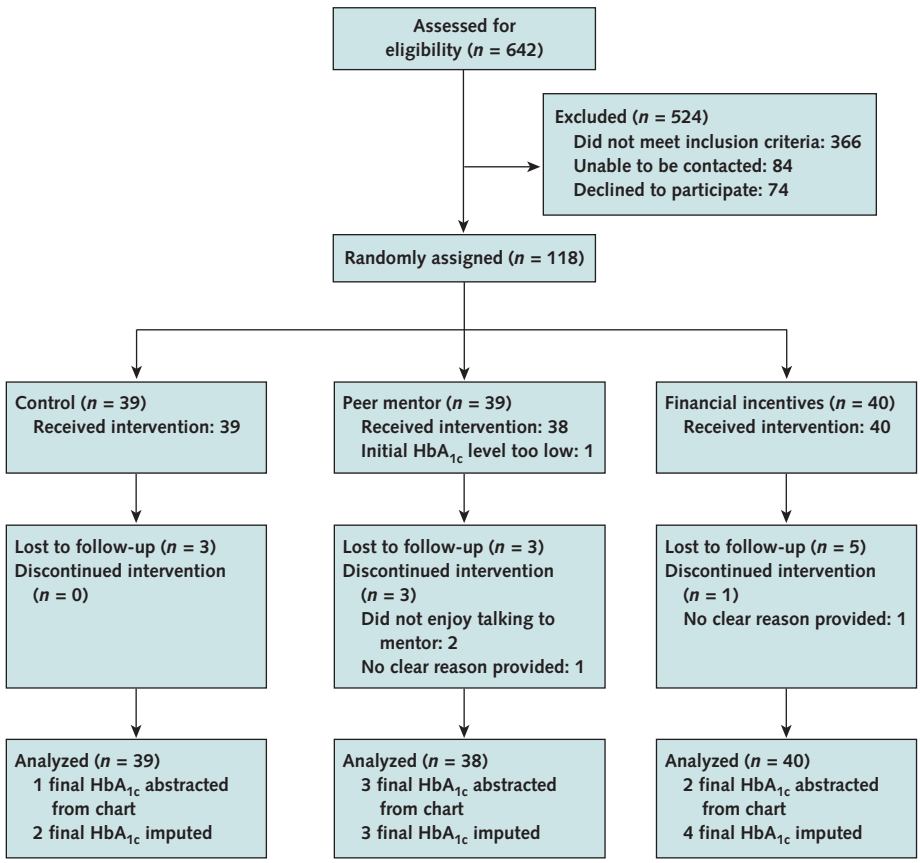
The intervention was short term. All patients were African American veterans, and most were men.

Implication

Peer mentorship can improve glucose control.

—The Editors

Figure 1. **Study flow diagram.**



HbA_{1c} = hemoglobin A_{1c}.

techniques (31). The training guide started by asking the mentor to talk with his or her to learn his or her background, understand his or her motivations, help identify the differences between his or her behaviors and goals, and help identify a realistic plan for goal achievement. Open-ended questions were encouraged and modeled. Mentors were also taught how to follow up and assess progress. Sample questions were provided, but mentors were also encouraged to draw on their own experiences. Calls were not monitored. No face-to-face meetings between mentors and mentees were required—mentors were given the telephone number of their mentees and informed that they would receive $20 per month if the mentees confirmed that they talked at least once per week. Mentors were contacted once per month to provide training reinforcement and to answer questions about their interactions with their mentees. Mentors were given $25 at the end of the training and after completing a short exit interview.

Study participants randomly assigned to the financial incentive group were told that they could earn $100 at 6 months if their HbA_{1c} level decreased by 1% and $200 if it decreased by 2% or to 6.5%—a level chosen instead of more aggressive targets. A day after enrollment, patients were notified by telephone of their starting HbA_{1c} level and personal goals. For example, patients with a starting HbA_{1c} level of 11% were told they could earn $100 if their final level was between 9.1% and 10% and $200 if it was 9% or lower. A patient with a starting HbA_{1c} level of 8% could earn $100 if his or her final level was between 6.6% and 7% and $200 if it was 6.5% or lower.

Outcomes and Follow-up

Our primary prespecified outcome was change in HbA_{1c} levels with treatment assignments as randomly assigned and incorporating all available data. When available, HbA_{1c} samples drawn during routine clinical practice and within 30 days of the intended study end date were used for patients who missed their study follow-up appointment; otherwise, we imputed follow-up values.

All patients were called monthly to assess for hypoglycemic symptoms to determine the safety of the interventions (a prespecified secondary aim). Patients were asked how many times in the past month they had symptoms of low blood sugar and how many times in the past month they had severe symptoms of low blood sugar, such as passing out or needing help to treat the reaction. If the

answer to the latter question was more than zero, follow-up questions were asked about what kind of help they needed and if they went to the hospital. Events in which patients passed out or required assistance, went to the emergency department, or were hospitalized were considered potential study-related serious adverse events. Patients also frequently reported hospitalization unrelated to hypoglycemic symptoms. These cases were reviewed by one of the authors who was blinded to the group assignment. All hypoglycemic events were considered potentially study-related. Finally, short qualitative exit interviews were conducted with 28 patients and 24 mentors in the peer mentoring group. Patients and mentors were asked if they liked the program, what they believed were the best and worst aspects of the program, and how it could be improved.

Statistical Analysis

We based our sample size estimate on a clinically relevant difference of 1.5 (32) for the change in HbA_{1c} level in the intervention groups, relative to control. To account for the 2 comparisons of interest (peer mentoring vs. control and financial incentives vs. control), we used a 2-sided significance of 0.025 for each comparison. Assuming an SD between 1.5 and 2.0 (17), equal variances across time and groups, and a within-participant correlation of 0.5 to 0.6 with power at 80%, we estimated that 21 to 38 patients per group would be required.

We evaluated the change in HbA_{1c} level as the dependent variable. We included baseline HbA_{1c} level as an adjustment variable because the maximum possible change in HbA_{1c} level is limited by the biological lower bound. We included patient characteristics that were not balanced between intervention groups and control as additional adjustment variables. To assess balance, we calculated standardized differences between each intervention group and control for each characteristic and included variables whose standardized difference was greater than 10% as main effects in a linear additive model. We selected the change in HbA_{1c} level instead of final HbA_{1c} level as the dependent variable because its distribution was consistent with the assumed normality for linear regression. Our primary analyses are based on everyone enrolled as randomly assigned, except for the 1 person who was excluded at baseline because of a low HbA_{1c} level. We used multiple imputation to generate values for each patient with missing follow-up data (33). Our multiple imputation procedure simulated a multivariate normal distribution for all variables in the primary analysis model. Each of 10 imputed complete data sets was analyzed, and the results were combined for inference (33). All analyses were completed using SAS, version 9.2 (SAS Institute, Cary, North Carolina).

The multiple imputation method assumes that data are missing at random (34, 35) or that missingness depends on observed variables only. We performed additional analyses to assess the robustness of our results and appropriateness of this assumption. First, we confirmed that all patient characteristics associated with missing final HbA_{1c} information were included in the imputation model. We then repeated the primary analysis and included only patients who had complete data. We also repeated the primary analysis with time included in the study as a covariate to account for the longer times between baseline and follow-up HbA_{1c} tests in the peer mentor group (which occurred because of the matching process). The results of the sensitivity analyses were similar to the original model, and we report only the results from the original model.

Not all patients had complete responses for the 6 monthly follow-up calls assessing hypoglycemic symptoms. We checked the amount of missing information by comparing the proportion of patients who completed 0 to 3 calls with those who completed 4 to 6 calls by group. Minor hypoglycemic events were summarized by treatment group on the basis of the proportion of completed monthly follow-up calls in which 0, 1 to 3, or more than 3 minor hypoglycemic events were reported. We compared the occurrence of hypoglycemic events between groups by modeling the ordinal event outcome in a multinomial generalized linear mixed model after checking the proportional odds assumption. We included a fixed effect for study group and accounted for clustering of repeated measures within participants with random-participant intercepts.

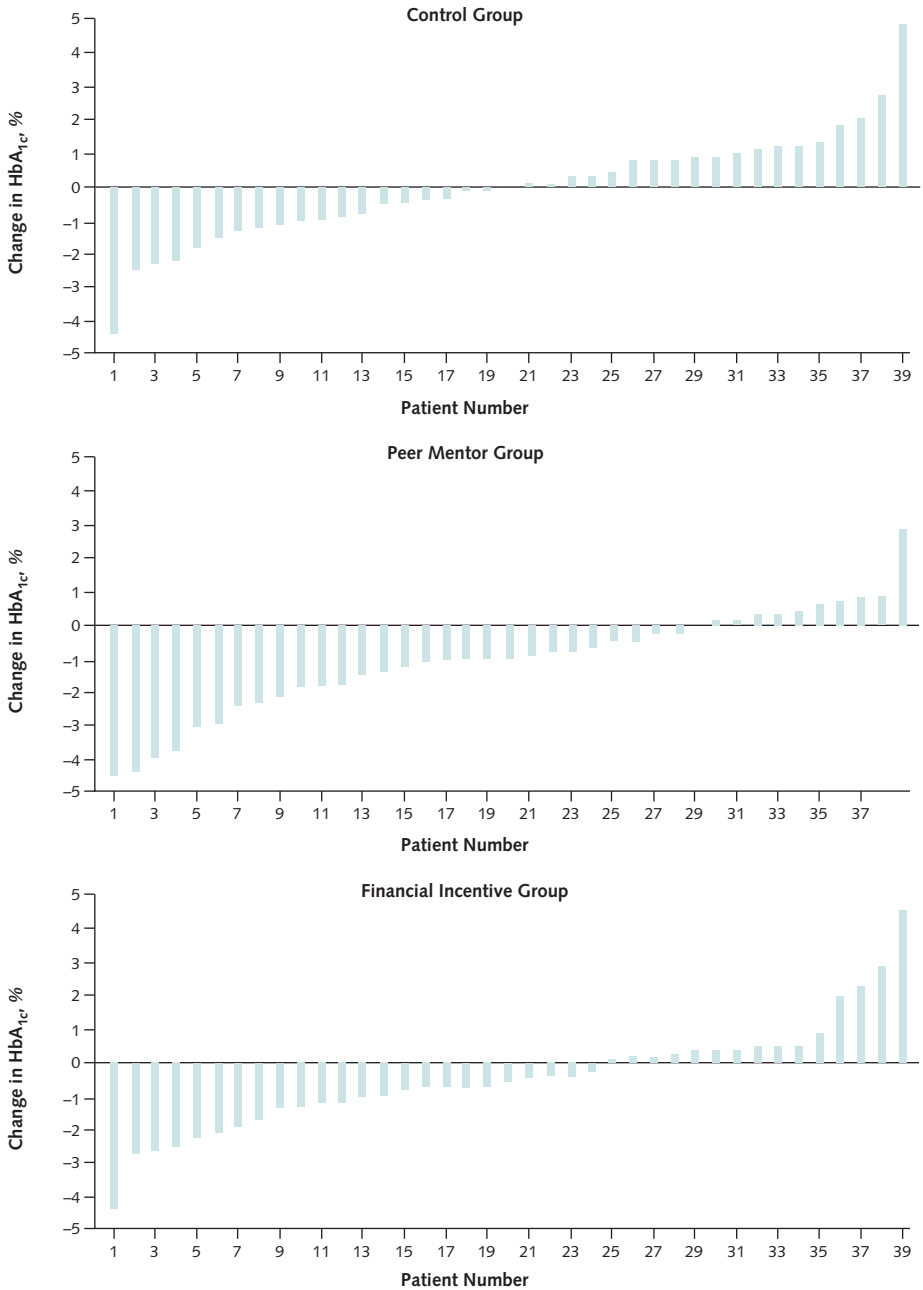
To assess the representativeness of our results, we compared the rates of minor hypoglycemic events among patients who completed 0 to 3 monthly calls versus those of patients who completed 4 to 6 monthly calls overall and by study group. To do this, we modeled the ordinal event outcome as above and included follow-up call completion status, study group, and an interaction term between study group and call completion status as independent variables.

Table 1. **Patient Characteristics**

Characteristic	Usual Care Group (n = 39)	Peer Mentor Group (n = 38)	Financial Incentive Group (n = 40)
Mean age (SD), y	60 (4)	60 (5)	59 (5)
Male, %	92	100	90
Education ≤12 y, %	64	68	50
Married, %	46	58	38
Receiving insulin, %	72	71	63
Diabetes >10 y, %	67	55	52
Any complication from diabetes, %	92	82	98
Current smoker, %	33	47	28
All health care at VA, %	74	74	73
Good self-reported adherence, %	67	79	80
Mean baseline HbA_{1c} level (SD), %	9.9 (1.6)	9.8 (1.8)	9.5 (1.2)
Mean days between tests (SD)	185 (11)	195 (15)	185 (13)

HbA_{1c} = hemoglobin A_{1c}; VA = Veterans Affairs.

Figure 2. **Change in HbA_{1c} for each patient, by group.**



HbA_{1c} = hemoglobin A_{1c}.

Role of the Funding Source

The work was funded by a National Institute on Aging Roybal Center pilot grant. The funding source was not involved in the design, conduct, or reporting of the study.

RESULTS

The enrollment rate of participants contacted and eligible was 61% for patients with poor control and 52% for mentors. The only statistically significant difference between the groups at baseline was the number of patients with complications from diabetes (**Table 1**). The mean baseline HbA_{1c} level was 9.9% (SD, 1.6%) in the control group, 9.8% (SD, 1.8%) in the peer mentor group, and 9.5% (SD, 1.2%) in the financial incentive group. The mean baseline HbA_{1c} level for peer mentors (based on chart review that made them eligible for the study) was 6.7% (SD, 0.6%).

Table 2. **Mean Change in HbA_{1c} Level**

Mean Change	Usual Care Group	Peer Mentor Group	*P* Value	Financial Incentive Group	*P* Value
From baseline (95% CI), %	−0.01 (−0.52 to 0.51)	−1.08 (−1.62 to −0.54)	—	−0.46 (−1.02 to 0.10)	—
Relative to control (95% CI), %*	—	−1.07 (−1.84 to −0.31)	0.006	−0.45 (−1.23 to 0.32)	0.25

HbA_{1c} = hemoglobin A_{1c}.
* Model covariates: baseline HbA_{1c} level, marital status, insulin use, diabetic comorbid conditions, duration of diabetes, and self-reported adherence. Missing final HbA_{1c} measurement for 9 patients was handled by using multiple imputation multivariate normal models, including change in HbA_{1c} (final minus initial), treatment group, baseline HbA_{1c} level, marital status, insulin use, diabetic comorbid conditions, duration of diabetes, and self-reported adherence.

On average, HbA_{1c} levels decreased from 9.9% to 9.8% in the control group, from 9.8% to 8.7% in the peer mentor group, and from 9.5% to 9.1% in the financial incentive group (**Figure 2**). After adjustment for covariates, the mean change relative to control (**Table 2**) was −1.07% (95% CI, −1.84% to −0.31%) in the peer mentor group and −0.45% (CI, −1.23% to 0.32%) in the financial incentive group.

Only 2 serious adverse events that were attributable to hypoglycemia occurred (**Table 3**). No enrollee was removed from the study for a serious adverse event. Taking into account repeated measures within patients, we found no evidence of statistically significant differences between treatment groups in the occurrence of minor hypoglycemic events.

Mentors and mentees talked the most in the first month, with a mean of 4 (range, 0 to 30) calls per month. Fourteen mentors (38%) received payment for talking at least 4 times during the first month. By the sixth month, the mean number of calls was 2 (range, 0 to 10) and only 6 mentors (16%) received payment. We do not know whether declining calls reflected decreased motivation or perceived reduction in need; we did not observe a dose–response relationship between the number of calls made and change in HbA_{1c}.

Twenty-four of 37 (65%) mentors completed the exit interview. Compared with mentors who did not complete the exit interview, those who did complete the interview were less likely to be married and more likely to have had diabetes for more than 10 years, but these differences were not statistically significant because of small sample size. Mentors most appreciated helping others (12 of 24), communicating with their mentee (7 of 24), and the teaching process (7 of 24). Fifteen mentors believed it was important that they at one time did not have good control. The main concerns raised by the mentors included scheduling calls (5 of 24), disinterested mentees (5 of 24), and talking about non–diabetes-related issues (4 of 24). Fifteen mentors recommended face-to-face meetings, and 5 believed that we should have screened mentees better for willingness.

Twenty-eight of 38 (74%) patients completed the exit interview. Patients who completed the exit interview were similar to those who did not. Of the 28 patients who completed the exit interview, 14 believed that the mentoring experience was educational and 5 mentioned that they appreciated the common understanding and life experiences. Six patients reported that there was too little contact. Twenty patients liked that the mentor had diabetes and believed that it was an important part of the program. The aspects of the program that the patients liked best were the support (14 of 28), education (9 of 28), and ability to commiserate with mentors (6 of 28). The main concerns raised by patients included difficulty getting in touch with the mentor (4 of 28) and lack of compatibility (3 of 28). Eleven patients believed that no changes were necessary, whereas 6 requested more calls and 8 requested face-to-face meetings.

DISCUSSION

In this well-tolerated randomized, controlled trial, a 6-month intervention of peer mentors had a statistically significant effect on improvement of glucose control. On average, patients in the peer mentor group decreased their HbA_{1c} levels by close to 1% compared with the control group, whereas patients in the financial incentive group decreased their HbA_{1c} levels by 0.5% compared with the control group. The latter change was not statistically significant; however, because of wide CIs, we cannot conclusively state that the intervention was ineffective.

Matching peers by race, sex, and age made the peer mentor intervention innately culturally competent in that peers and mentees came from the same cultural background (1, 36). Because the intervention relied

Table 3. **Adverse Events, by Study Group**

Adverse Event	Usual Care Group (*n* = 39)	Peer Mentor Group (*n* = 38)	Financial Incentive Group (*n* = 40)
Deaths, *n*	0	0	0
Any ED visit or hospitalization, *n*	7	8	10
Passing out, ED visit, or hospitalization due to hypoglycemia, *n*	1	0	1
Minor hypoglycemic symptoms, *n (%)**			
0 symptoms	142 (71)	107 (61)	121 (64)
1–3 symptoms	38 (19)	52 (30)	51 (27)
>3 symptoms	21 (10)	15 (9)	16 (9)

ED = emergency department.
*201 calls were completed in the control group, 174 calls in the peer mentor group, and 188 calls in the financial incentive group.

heavily on the mentors' personal experience, training was minimal and easy to implement. The effect size observed was large compared with many other behavior interventions (37–39).

Several factors may have contributed to the success of the peer mentoring intervention. First, it may have benefited from a culture of camaraderie among the patients. Second, a long history of mistreatment and distrust in the health care system (40, 41) may make peer support particularly effective for African Americans. Third, both intervention groups in our study may have benefited from the stringent inclusion criteria. In a prior study that successfully used reciprocal peer support for veterans with diabetes, the intervention was especially successful relative to nurse care management for those with a baseline HbA_{1c} level above 8% (11). We chose a group with persistently poor control because such persons are at greatest risk for complications. Fourth, we provided mentors with $20 to talk at least 4 times per month to their mentee. This is itself a financial incentive, albeit a small one, and may have motivated mentors to call more frequently. This must be considered when contemplating both the efficacy and the cost of the program.

Peer mentoring was done solely by telephone, increasing its broad applicability and scalability. Although both patients and peer mentors indicated that they would have appreciated face-to-face introductions, the peer mentor group was remarkably effective without such an introduction. An intervention of this sort could be especially effective in rural or suburban settings where contact by telephone is relatively easy, whereas frequent visits to a health care provider for provider care or group support might be difficult. Finally, perhaps the most obvious attraction of this type of peer mentoring is that it is virtually free, almost certainly enhancing its cost-effectiveness relative to more expensive interventions, such as nurse care management, telemedicine, and group medical appointments (17, 18, 42).

In this study, no concerns about violations of privacy or safety were raised by patients. Although additional privacy safeguards could be implemented, for these programs to work, the mentee needs to be willing to divulge some personal information about their difficulty with disease control. Making this clear up-front to patients is essential.

We may not have observed as large a decrease in HbA_{1c} levels in the financial incentive group as we did in the peer mentor group because of the lack of feedback on glycemic control between the first visit and the follow-up visit 6 months later. Growing evidence shows that financial incentives are more effective when there is frequent feedback (19–21, 23, 43). However, financial incentives are controversial. Opponents of financial incentives worry about undue influence in low-income populations and the implication that individuals could improve their health status given the proper incentives (44, 45). Others believe that financial incentives encourage patients to take a more active role in promoting their own health (23, 46). Financial incentives that reward healthy behaviors can be seen as nonpunitive; however, programs where persons are penalized for behaviors, such as smoking, are seen by some as unfair (44, 47, 48). The American College of Physicians is in favor of incentive programs as long as they are evidence-based, are culturally sensitive, and respect autonomy (49). Although this study does nothing to resolve this debate, it does add to the existing evidence.

We chose to limit inclusion in this study to patients whose most recent 2 HbA_{1c} readings were above 8%. Patients with poor control may be asked to return to the clinic more frequently. Given recent evidence that intensive glucose lowering may not be optimal (50, 51), we targeted patients who would clearly benefit from improved control. We were successful in finding a group with poor baseline control who did not respond to usual care, as evidenced by a decrease in HbA_{1c} level of only 0.01% for patients in the control group. However, this design does limit the generalizability of the study and we do not know whether the intervention would have been as effective in a population with only 1 HbA_{1c} reading above 8%.

Patients in the study were all African American veterans at 1 institution. Further research should examine the efficacy of a similar intervention on a broader population.

Future studies are necessary to determine the sustainability of these effects. The effects of behavioral interventions frequently wane after the intervention is completed (20, 21, 52, 53). One possible approach to maintaining sustainability would be to transition patients who achieve control from mentee to mentor roles. Prior research has found that peer support is beneficial not only to those receiving it but also to those giving it (1), because mentors may be highly motivated to maintain control to set a good example. In conclusion, this peer mentor intervention shows promise as a scalable approach to creating a mechanism to help patients at higher risk for diabetic complications decrease HbA_{1c} levels.

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Reproducible Research Statement: *Study protocol*: Available at www.cherp.org. *Statistical code*: Available from Dr. Long (e-mail, jalong@mail.med.upenn.edu). *Data set*: Not available.

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