Impact of Telephonic Interventions on Glycosylated Hemoglobin and Low-density Lipoprotein Cholesterol Testing

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Objectives: To determine whether diabetes disease management (DM) programs are able to improve adherence to glycosylated hemoglobin (A1C) and low-density lipoprotein cholesterol (LDL-C) clinical testing in a nonadherent population and to quantify the efficacy of telephonic interventions in improving clinical testing rates.

Study Design: Retrospective, observational cohort study before and after DM program implementation.

Methods: A baseline cohort of members with diabetes (n = 5640) was identified from among large-scale diabetes DM programs administered for 13 geographically diverse health plans. Members were defined by nonadherence at baseline to A1C and/or LDL-C testing, grouped together based on how long they had participated in the program, divided retrospectively into telephonically contacted and uncontacted groups, and analyzed in the subsequent 12-month implementation period for testing rates. Subgroups defined by disease burden at baseline and frequency of telephonic interactions were analyzed to determine achievement of guideline-based A1C and LDL-C testing rates.

Results: Participation in diabetes DM programs was associated with improved A1C and LDL-C testing rates in previously nonadherent members. Calling nonadherent members improved A1C testing by 30.2% and LDL-C testing by 10.9% compared with testing rates for members who were not called. Members with high disease burden benefited even more from the diabetes intervention. Frequency of telephonic contacts with nonadherent individuals demonstrated a linear relationship with improved rates of adherence to A1C and LDL-C testing guidelines, and markedly improved testing rates compared with a not-called group.

Conclusion: Telephonic interventions as part of comprehensive DM programs are associated with improved disease-monitoring testing.

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For author information and disclosures, see end of text.

Disease management (DM) comprises a heterogeneous group of patient-support and educational services that can enhance clinical control and increase quality of life for people living with a variety of diseases. DM programs can vary widely in their content, intensity, mode of delivery, automation, and extent and nature of patient and physician engagement.[1] In recent meta-analyses of DM programs, researchers trying to make a valid synthesis of disparate studies' outcomes were challenged to find commonality across study interventions.[2-4] Such studies indicate the need to better characterize the efficacy of specific DM interventions. Not all DM programs are assured of success.[5] Knowledge of efficacious DM components is desirable both for the efficient and effective design of new DM programs and for the expansion of existing ones. For example, the Centers for Medicare & Medicaid Services has identified the need for quantifying the efficacy of components that drive both case and disease management results.[6-9]

Type 2 diabetes mellitus is one of the most common chronic diseases among adults in the United States. Poorly controlled glycosylated hemoglobin (A1C) levels over time are causally associated with debilitating organ and vascular complications, and elevated low-density lipoprotein cholesterol (LDL-C) is associated with vascular complications.[10-12] Evidence-based clinical guidelines for diabetes control include regular A1C and LDL-C testing. Adherence to these guidelines is associated with improved clinical and financial outcomes.[13,14] However, testing rates are low despite some improvements attributable to increased knowledge of the clinical[15-18] and economic[19,20] benefits, and an increased ability to provide better diabetes glycemic control.

A factor contributing to the success of any DM program is its ability to deliver improved adherence to evidence-based care. The purpose of this study is to quantify the impact of telephonic intervention as part of Healthways' diabetes DM programs on A1C and LDL-C testing rates. Telephonic interactions with members are integral to most DM programs, including those for diabetes.[21] Although it is logical that telephonic interactions will encourage testing for LDL-C and A1C to ensure disease control, the

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relationship between calls and testing rates in a previously nonadherent population has not been established.

METHODS

Study Population

Health plans initiated diabetes DM programs at different times. Start times were aligned among the 13 plans by focusing on the number of months members participated in a program rather than a particular contract or calendar date. Baseline was comprised of months 0-12, and the intervention year (DM year 1) was comprised of months 13-24.

Telephonic Intervention and Clinical Testing

Call frequency was determined by extracting data from a proprietary clinical expert system (PopulationWorks, Healthways, Inc), which guides patient conversations with respect to collection of demographic information, clinical data, and general health assessment information. Based on the assessment information obtained, this system prompts appropriate interventions and provides the nurse with content and approaches based on embedded evidence-based guidelines.

During the course of routine calls to diabetes DM participants, the nurse reviewed the electronic record for evidence that an A1C and/or LDL-C test had been performed in the last 12 months. If tests had not been performed, the nurse addressed the rationale, benefits, and recommended frequency of A1C and LDL-C testing for optimal diabetes control. Calls where clinicians successfully communicated with members or caregivers (excluding answering machine messages, instances where member answers but doesn't have time to talk, etc) were defined as a "call" for the purpose of this study. The number of successful calls made to an individual member was recorded in the call activity module of the database. This value was reported as the frequency of telephonic contacts in relationship to A1C and LDL-C testing in these analyses.

Member Eligibility and Characteristics

Members included in this study came from 13 health plans offering the Healthways diabetes DM programs and were continuously enrolled during the baseline year and DM year 1. The diagnosis of diabetes was inferred by an algorithm using input data from inpatient, outpatient, and pharmacy administrative claims. Members who were nonadherent with A1C and/or LDL-C testing during the baseline year were identified. Member demographic characteristics of age and sex were derived from membership data.

The Johns Hopkins Adjusted Clinical Group Case-Mix System tool[22] was used to adjust for the impact of disease burden on testing rates. With this tool, disease burden was estimated by the amount of healthcare resources a member utilized over the past year and on the patterns of disease to help determine case mix. Ranking was expressed as a resource utilization band (RUB) score that ranged from 0 (no utilization) to 5 (highest utilization).

For this study, testing adherence was defined as 1 or more tests in the 12-month study period. Clinical test group adherence definitions include:

- A1C: Members who did not have an A1C test in the baseline year.
- LDL-C: Members who did not have an LDL-C test in the baseline year.
- A1C + LDL-C: Members who did not have one or both tests in the baseline year. Overlap among members in the A1C and LDL-C groups does exist. The A1C + LDL-C group represents the number of discrete members evaluated.

Members who did not have a test during the baseline year (nonadherent) were evaluated for adherence to A1C and/or LDL-C testing during DM year 1. The relative percent improvement in clinical testing for called members versus not-called members was calculated based on the testing rates for called members compared with the testing rates for not-called members during DM year 1.

Statistical Analyses for Improvement in Clinical Testing

Statistical analyses were performed using SAS software, version 9.1.3 (SAS Institute, Inc, Cary, NC). To compare the called and not-called groups, the Cochran Mantel-Haenszel (CMH) χ^2 procedure was utilized, and *P* values were reported from this analysis. Potential age, sex, and disease burden differences were statistically evaluated as follows: age and age group (0-19, 20-64, 65-75, or >75 years of age) by the *t*-test and the χ^2 test; sex by Fisher's exact test; and disease burden by the χ^2 test and the nonparametric Wilcoxon 2-sample test. Age and disease burden were identified as confounding variables (Table). As such, age and disease burden were accounted for in the CMH χ^2 analyses to prevent these covariates from biasing the results.

Whether receiving calls resulted in significantly improved A1C and/or LDL-C testing was evaluated using the CMH χ^2 procedure, and the *P* values from this test were reported. Similarly, the differences in clinical testing rates were compared for members with high disease burden (RUB score 4-5) versus members with low disease burden (RUB score

Table. Demographic Characteristics of Called and Not-called Health Plan Members in Diabetes Disease Management Programs

Clinical Test and Characteristic*	Not Called	Called	*P*
A1C			
Average age, y	50.8	56.2	<.0001
% Female	49.4	45.4	.0715
Average RUB	2.6	2.9	<.0001
LDL-C			
Average age, y	48.4	53.1	<.0001
% Female	47.9	48.7	.8245
Average RUB	2.7	3.0	<.0001
A1C + LDL			
Average age, y	49.2	53.6	<.0001
% Female	48.5	48.4	.9808
Average RUB	2.8	3.0	<.0001

*A1C indicates members who did not have an A1C test in the baseline year; LDL, members who did not have an LDL test in the baseline year; A1C + LDL-C, members who did not have 1 or both tests in the baseline year.
A1C indicates glycosylated hemoglobin; LDL-C, low-density lipoprotein cholesterol; RUB, resource utilization band.

0-3). Age and call status were accounted for in the CMH χ^2 procedure, and *P* values were reported. The percent improvement for called versus not-called members was calculated and reported as above.

To determine the effect of call frequency on clinical testing rates, the number of calls ranging from 0 to 4 was evaluated. Age and disease burden (high or low RUB score) also were included the analysis of covariance and were accounted for in the CMH χ^2 correlation statistic. It is important to note that for the purpose of this study, analyses focused on up to 4 calls; however, members may have received more than 4 calls during the 12-month intervention period.

RESULTS

Of 12 876 members with continuous participation, 5640 distinct members had no medical claims for an A1C or LDL-C test (ie, zero adherence) in the baseline year prior to the start of DM intervention. Of the 5640 members, 46.5% were female. Their average age was 54.2 years, and their average RUB score (disease burden) was 3.12.

Of the 5640 members not adherent to A1C and LDL-C testing at baseline, 1675 (29.7%) did not receive calls (only received program mailings) during DM year 1, primarily because of inaccurate phone numbers. Members who received calls from nurses (n = 3965) during DM year 1 were compared with members who were not called (n = 1675). Members who received calls had higher rates of testing than those who only received DM mailings. In **Figure 1A**, the relative increases in testing are illustrated, and the *P* values are indicated. A total of 3274 members did not receive an A1C test before the DM program (baseline). Called members had a 30.2% improvement in A1C testing compared with members who were not called during DM year 1. Statistically significant improvements were also observed for called members compared with not-called members for LDL testing and A1C + LDL-C testing.

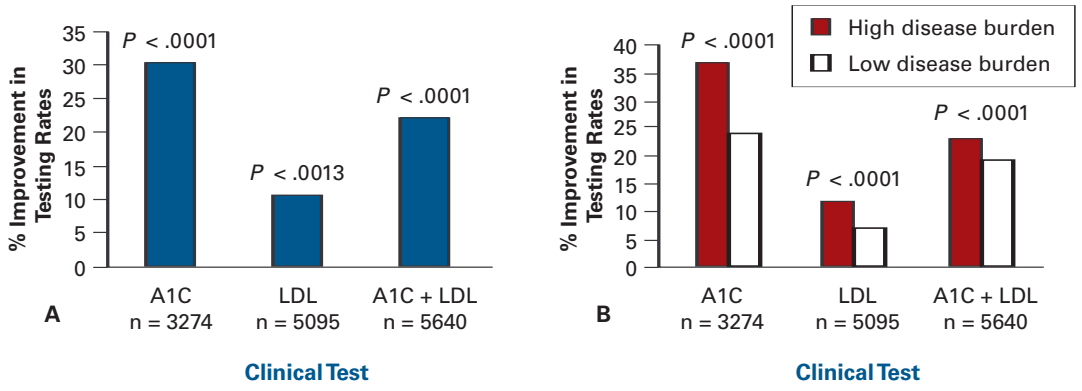
The disease burden of members who did not have an A1C test, an LDL-C test, or either test was identified. In general, called members with higher disease burden showed greater improvement in testing than called members with low disease burden (**Figure 1B**). For instance, called members with high disease burden had a 34.6% relative increase in A1C testing compared with not-called members with high disease burden. In comparison, called members with low disease burden had a 24.2% increase in A1C testing compared with not-called members. Overall, members with high disease burden achieved greater improvement in testing than members with lower disease burden during DM year 1 (χ^2 test; $P < .0001$). This observation underscores the importance of adjusting for member characteristics (eg, disease burden) when evaluating the impact of a DM program.

There was a strong linear relationship between telephonic care calls and testing rates when the number of calls was plotted against A1C or LDL-C testing (χ^2 test; $P < .0001$). **Figure 2** illustrates the relationship, which remained after controlling for severity of disease and age. Members who were called 4 times had the greatest improvement compared with members who were not called at all, achieving a 45.2% increase in A1C testing and a 15.4% increase in LDL-C testing.

DISCUSSION

Studies of the efficacy of individual components of DM programs are rare and difficult to conduct in the context of

Figure 1. Impact of Telephonic Intervention on Clinical Testing Adherence for All Members (**A**) and by Disease Burden (**B**)



A1C indicates glycosylated hemoglobin; LDL, low-density lipoprotein.

population-wide multimodal interventions typical of health plan and provider organization programs.[2,23,24] These retrospective analyses of telephonic contacts were performed on members with diabetes who participated in a large-scale DM program at 13 geographically diverse health plans and who, during the baseline year, were nonadherent for key aspects of diabetes control: A1C and LDL-C testing.

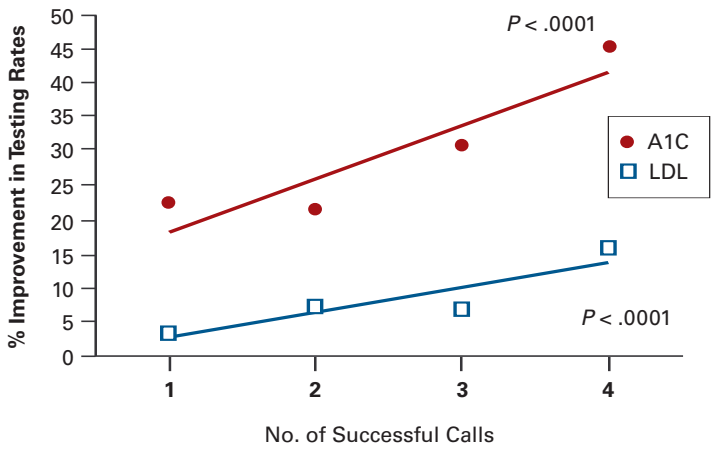
Important to this approach is the comparability of the called and the not-called groups during the DM intervention year. Not-called members were not randomized; rather, their not-called status mostly was because of absent or inaccurate telephone numbers recorded by their health plans. There was statistically significant evidence of age and disease burden differences between the called and not-called groups. It is speculated that members with inaccurate telephone numbers might be less likely to utilize healthcare, experiencing a long interval between physician visits; therefore, they would have less opportunity to update their clinical information. Alternatively, they could have less severe disease, as observed in this study. In comparison, members with accurate telephone numbers might utilize healthcare services more frequently and have higher disease burden. Such issues did not influence the results of this study because healthcare utilization and disease burden were accounted for. Future studies may explore additional variables, such as socioeconomic status, that could potentially influence the responsiveness of members to telephonic interventions.

Participation in the diabetes DM program was associated with improved A1C and LDL-C testing in members who previously were nonadherent. Telephonic care calls promoted healthy behavior, including obtaining an A1C or LDL-C test. All members who received calls achieved statistically significant improvement in testing compared with members who did not receive calls. Increasing the numbers of calls was associated with increasing percentages of testing rates and is consistent with a dose-response relationship between telephonic activity and adherence. Members with high disease burden benefited even more from the diabetes intervention.

CONCLUSION

This large-scale study is the first to demonstrate that telephonic activity as part of a DM program can improve the rates

Figure 2. Association Between Call Frequency and Clinical Testing Adherence



A1C indicates glycosylated hemoglobin; LDL, low-density lipoprotein.

Take-away Points

Telephonic intervention as part of disease management programs promoted increased clinical testing rates in a previously nonadherent diabetes population. These findings demonstrate that:

- Telephonic interventions delivered by experienced registered nurses are effective in educating individuals with diabetes about diabetes standards of care and encouraging these individuals to put this knowledge into action.
- Nurse-delivered telephonic intervention to improve adherence to diabetes guidelines may be a useful tool for healthcare providers and policy makers to improve the quality of care received by individuals with diabetes.

of LDL-C and A1C testing in previously nonadherent members with diabetes and aid in narrowing the gaps in chronic care management. Future studies will assess the association between increased testing adherence and improvement in clinical and financial outcomes, as the improvement in clinical testing is likely associated with improved diabetes outcomes coupled with reduced healthcare utilization rates and costs.

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