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Costs and Effects of a Telephonic Diabetes Self-Management Support Intervention Using Health Educators

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Abstract

Background—Self-management is crucial to successful glycemic control in patients with diabetes, yet it requires patients to initiate and sustain complicated behavioral changes. Support programs can improve glycemic control, but may be expensive to implement. We report here an analysis of the costs of a successful telephone-based self-management support program delivered by lay health educators utilizing a municipal health department A1c registry, and relate them to near-term effectiveness.

Methods—Costs of implementation were assessed by micro-costing of all resources used. Per-capita costs and cost-effectiveness ratios from the perspective of the service provider are estimated for net A1c reduction, and percentages of patients achieving A1c reductions of 0.5 and 1.0 percentage points. Oneway sensitivity analyses of key cost elements, and a Monte Carlo sensitivity analysis are reported.

Results—The telephone intervention was provided to 443 people at a net cost of $187.61 each. Each percentage point of net A1c reduction was achieved at a cost of $464.41. Labor costs were the largest component of costs, and cost-effectiveness was most sensitive to the wages paid to the health educators.

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Conclusions—Effective telephone-based self-management support for people in poor diabetes control can be delivered by health educators at moderate cost relative to the gains achieved. The costs of doing so are most sensitive to the prevailing wage for the health educators.

Keywords

Cost-effectiveness; telephone-based care; health educators; diabetes; HbA1c

1. Introduction

Health care spending has risen faster than the rest of the United States economy for the past several decades, and is now swamping federal and state government budgets. The rising cost of health care has important consequences: either spending on other programs (e.g., education, public safety, and infrastructure) must be reduced, or taxes must rise, or the budget deficit must grow larger. (Silver, 2013.)

Type 2 diabetes mellitus is a chronic disease that can lead to severe complications when it is not controlled, and it is increasing in prevalence (American Diabetes Association, 2013). Self-management is a crucial part of treating patients with this disease, but can be challenging for patients. Successful self-management requires integrating new ways of eating, routine physical activity and medication adherence into the complexities of daily life (American Diabetes Association, 2015). These challenges may be even greater for people of limited means or people who live in low-income neighborhoods (Hill et al., 2013). Helping patients deal with these difficulties can be time/labor intensive, is typically not directly addressed by physicians and nurses in the clinic, and might be costly for the health care system if carried out by higher-paid personnel. Self-management support by peers, community health workers, or health educators has been implemented successfully (Walker et al., 2008, Walker et al., 2011, Bogner et al., 2012, Suksomboon et al., 2014) and can be reasonably economically efficient for some patient outcomes (Schechter et al. 2012).

Cost-effectiveness analysis is one approach to assessing the value provided by a treatment strategy. One key principle is that cost-effectiveness is comparative, not absolute: the intervention of interest should be compared with the next best alternative therapy. Another important principle is that even costly interventions may still be quite valuable if they are sufficiently effective: it is the balance between costs and health effects that matters. Clinical effectiveness is not an inherent property of a specific intervention but varies depending on the clinical characteristics of the patients treated. A key to practicing cost-effective medicine is to target treatments precisely to the patients and indications for which they are truly effective, because clinical effectiveness is a key determinant of cost-effectiveness. Thus, cost-effectiveness analysis examines the ratio of costs to effects of a specific treatment in a specific patient population, comparing this to the next best alternative.

Here we report a cost-effectiveness analysis of a telephone-based self-management support intervention delivered by health educators employed by the New York City Department of Health and Mental Hygiene (NYC DOHMH) and supervised primarily by a certified diabetes educator (CDE) registered nurse, with some consultation with a primary care physician and a clinical psychologist. The target population was adult patients with diagnosed diabetes in the South Bronx, NY, where the population is predominantly Latino or Black, and poverty is highly prevalent (Walker et al., 2014, Chamany et al., 2015). A particular innovation of this program is that the NYC DOHMH A1c Registry (A1c Registry), an laboratory-based surveillance system, was used to identify eligible participants, and our intervention was implemented in the environment of patient and practice-level interventions offered in the A1c Registry Program (Chamany et al., 2009).

2. Methods

2.1 General

Methods of recruitment and the study intervention have been described elsewhere (Walker et al., 2014, Chamany et al., 2015). Briefly, residents of the south Bronx with an A1c > 7.0% were identified from the A1c Registry and contacted by telephone. Those who met study eligibility criteria and consented were randomized to either a Telephone/Print (Tele/Pr) intervention or a Print Only (PrO) control arm. The A1c Registry Program consisted of outreach to care providers with reports of levels of glycemic control in their practices, and outreach to patients with elevated A1c or who were overdue for A1c testing with motivational letters to improve glycemic control or seek care. All study participants were mailed printed diabetes self-management support materials and periodic lifestyle incentives (e.g., 7-day pill boxes, pedometers) to remain in contact with the program and complete periodic questionnaires. Our Tele/Pr intervention consisted of 4 or 8 telephone calls over 12 months, depending on initial A1c level, from trained, supervised health educators to deliver behavioral counseling and self-management support. The trial was approved by the Institutional Review Boards of the Albert Einstein College of Medicine and the New York City Department of Health and Mental Hygiene, and was registered with ClinicalTrials.gov as NCT00797888 prior to the start of enrollment.

The perspective of our analysis is that of an organization with the information technology infrastructure needed to electronically identify patients with elevated A1c in order to implement a telephonic diabetes self-management support system for improving glycemic control in selected patients. We envision two distinct situations. An organization that already provides such services (such as an accountable care organization), seeking to add the telephone-based intervention to its repertoire, would face only the incremental costs of the telephone-based intervention. An organization that does not currently engage in patient self-management support, such as a public health department, would additionally face all of the start-up costs. In the former situation, an incremental cost-effectiveness analysis is most relevant, in the latter, total cost-effectiveness analysis applies. We present both approaches.

The intervention in question lasted one year, and outcomes were ascertained as available at the end of that time period within a pre-specified window around one year after randomization. We do not know whether the effects of the intervention are sustained after its completion. Consequently we adopt a one-year time horizon for the analysis. This limitation also makes it inappropriate to attempt a cost-utility analysis, as the longer term outcomes needed for that would require speculative projections.

2.2 Ascertainment of Costs

2.2.1 Labor—The health educators maintained logs recording the start and end time of each telephone call with participants, as well as any attempted call that did not reach the participant (incomplete call). Each call was preceded by an average of five minutes of preparation time to review the participant's records. Completed calls were followed by an additional five minutes time to write progress notes. In addition, the health educators received 1 hour of supervision per week (with occasional hiatuses), mainly from a nurse certified diabetes educators (CDE). A total of 120 hours of supervision took place over the 2.5 years of active intervention. A clinical psychologist and internist participated in some supervisory sessions to provide expert consultation to the team. Our best estimate is that each contributed 48 hours of effort to actual program operations during the three years of the study, excluding their contributions as co-investigators in the research.

The median hourly wage for health educators, $23.66, was obtained from the United States Bureau of Labor Statistics 2013 Occupational Employment and Wages survey (U.S. Dept. of Labor, 2013). For the supervising nurse CDE, we attributed a wage equal to the 75th percentile of wages paid to registered professional nurses in 2013 in the same survey, $38.55 (there is no category specifically for certified diabetes educators in the survey). We applied the median wages for clinical psychologists and internists, $32.58 and $89.83, respectively, to the time that they contributed to program operations. All wage rates were increased by 30% for fringe benefits.

2.2.2 Telephone Charges—Commercial telephone charges vary widely and large organizations, in particular, negotiate arrangements with telecommunications providers. We assumed that completed calls were billed at $0.05 per minute, and that incomplete calls incurred a fixed charge of $0.05.

2.2.3 Incentives and Print Materials—The incentives and print materials were distributed to both study arms, so the costs of these items do not figure in the incremental cost-effectiveness analysis of the telephone intervention. Actual purchase price and actual mailing costs are reported.

2.2.4 Facilities and Equipment—Telephone outreach to patients with diabetes is not a standard activity for a state or local health department. Accordingly, secure space and equipment were acquired to support this activity. Other organizations contemplating such a program might not need to do this, and even those needing to acquire extra space for this activity might not require the special equipment to secure the premises needed to protect the confidential information in a governmental registry, such as the A1c Registry. Equipment costs are initially reckoned at purchase price. However, after the program terminated, these items retained useful life and can be re-purposed. Because they were in service for this program for only four years, we reduce their cost by 20% (straight line 5-year depreciation).

The cost of space was assessed at US national average commercial rental rates (NY Startup Hub, 2014). The costs of space and durable equipment are excluded from the incremental cost analysis.

2.2.5 Inflation Adjustment and Discounting—For inclusion in cost-effectiveness ratios, the prices of supplies and durable equipment purchased in 2010 were increased by 9% to 2013 equivalent prices based on the Bureau of Labor Statistics inflation calculator (U.S. Dept. of Labor, 2013). Although the program as a whole operated for four years, each participant's involvement lasted only 12 months, and the A1c primary outcome was ascertained, as available, at the end of that year. Due to the one-year horizon, no discounting was applied.

2.3 Program Effectiveness Measures

We consider three measures of program effectiveness as denominators for cost-effectiveness ratios. The primary study outcome measure was reduction in A1c. Therefore, aggregate A1c improvement is the denominator for our first cost-effectiveness ratio. This aggregate measure of A1c change is a mixture of people with large improvements, small improvements, and some whose glycemic control worsened over the course of the study. The measure is calculated by multiplying the study's mean incremental effect on A1c by the number of people in the Tele/Pr arm having an end of program A1c measurement and is presented as percentage points of total A1c improvement per 100 program participants.

The other two outcomes we consider are the increased numbers of people decreasing A1c by 0.5 or 1 percentage point. To calculate these, we first calculate the proportions of people attaining these threshold improvement levels in each arm. The difference between them is the fraction of threshold attaining participants in the telephone/print arm attributable to the telephone intervention. That fraction is then multiplied by the number of people in the telephone/print arm with an end of program A1c measurement and is presented as the number of such patients per 100 program participants.

All outcome measures were calculated including each person in the study arm to which they were randomized, regardless of whether they received all (or any) of the assigned intervention. The calculation of the outcome measures treats participants lacking an end-of-study outcome measure as if their results were missing at random.

2.4 Cost Effectiveness Ratios

A cost effectiveness ratio (CER) is calculated as a total of costs divided by an associated measure of health effect. We report cost-effectiveness ratios based on both the total cost of the program and the incremental cost of the telephone intervention over print only. The former is of interest to an organization not currently involved in patient self-management support activities, whereas the latter would be of interest to an organization seeking to expand an existing self-management support program to include this telephone intervention. Cost effectiveness ratios are calculated for each of the three program effectiveness measures. We also report the costs per person served. Because long-term outcomes of the intervention are not known, and other health effects could not be measured in this trial, we do not estimate quality adjusted life years, nor report a cost-utility ratio.

2.5 Sensitivity Analyses

We carry out several one-way sensitivity analyses and a Monte Carlo sensitivity analysis. For the oneway sensitivity analyses, we consider separately the effects of different levels of prevailing wages, telephone charges, and commercial space costs. The base case and best and worst-case scenario assumptions are shown in Table 1. These one-way sensitivity analyses serve to demonstrate the relative importance of these aspects of the cost-effectiveness ratios.

For the Monte Carlo sensitivity analysis we use bootstrap re-sampling of the observed study outcomes to capture uncertainty in effect of the intervention on glycemic control, as well as Monte Carlo sampling of the wage rates for health educators, nurse CDE, clinical psychologist, and internist. The uncertainty in the wage rates is modeled as a multivariate normal distribution, centered at the base case values, with standard deviations of $2, $4, $4, and $8, respectively and off-diagonal correlations 0.14 (Schechter et al., 2012). We do not vary the costs of telephone charges, supplies, durable equipment, or space in these analyses because a decision maker contemplating a similar intervention would already have good information about these factors, and they would contribute little or nothing to the decision maker's uncertainty.

3. Results

3.1 Summary of Randomized Controlled Trial Outcomes

As has been reported elsewhere (Chamany et al. 2015), the study enrolled 941 participants, all with initial A1c > 7%, of whom 443 were randomized to the telephone intervention. End of study A1c was obtained in 334 Tele/Pr arm participants and in 360 Pr/O arm participants. The mean decline in A1c in the Tele/Pr arm exceeded that in the Pr/O arm by 0.43 percentage points (95% CI 0.09 to 0.74). The protocol called for participants with initial A1c ≤ 9.0% to receive 4 calls, and those with initial A1c > 9.0% to receive 8. Overall, the mean number of completed phone calls per participant was 4.6.

3.2 Costs

The quantity and total costs of each component of the Bronx A1c program are shown in Table 2. Of greatest importance, the costs unique to the telephone intervention totaled $83,110.62, and the total cost of the entire program was $185,846.81. The labor figures are based on median 2013 U.S. wages for the health educator and supervisor positions. The other figures presented there are in nominal dollars as of the time of acquisition (2010). Initial setup costs (office space and durable equipment) to create a program in an environment not already engaged in diabetes self-management support are a substantial proportion of the total. Note, however, that approximately 40% of this cost is for security systems, needed because of the DOHMH's obligation to protect the confidentiality of its registry information in a satellite office. An organization seeking to implement a diabetes self-management support program within its existing offices, or relying on less sensitive sources of information, might avoid this portion of setup costs.

The cost of incentives, which were used in both arms of the study, is approximately 20% of the total. The bulk of the cost of incentives is attributable to good quality pedometers (~$20/unit), which are not widely distributed in programs because of their cost. As they were provided to participants in both arms, these costs are excluded from the costs specifically attributable to the telephone intervention, but we include them in the total costs.

The costs most intrinsic to the telephone intervention are the labor costs and telephone charges. The latter are overwhelmingly dominated by the former, and time spent on completed calls and the associated record keeping account for over 75% of the labor cost. These costs are inherent to implementation of any telephonic self-management support program.

3.3 Cost-Effectiveness Ratios

3.3.1 Base Case—Total costs for the print only arm were $109.18 per person; those in the telephone/print arm cost $269.79. Thus, the cost specific to the telephone intervention was $187.61 per person. Total program costs were $419.52 per person. Table 3 shows the base case cost-effectiveness ratios for our program. The column headed Cost-Effectiveness Ratio Compared to Print Program shows the costs per unit outcome that are attributable only to the telephone intervention. These cost-effectiveness ratios are based only on the costs of labor and telephone charges, which are unique to the telephone intervention arm of the study, and they estimate the cost of expanding an existing self-management patient support program to include the telephone intervention. The figures in the final column of Table 3 are based on the total program costs, and would estimate the cost of implementing the telephone and print interventions in a setting currently lacking any self-management patient support program. The A1c reduction outcome represents the aggregate decline in A1c (in percentage points) per 100 program participants observed in the telephone arm beyond what occurred in the print only arm. The cost-effectiveness ratio for this outcome is $464.41 per percentage point A1c for expanding an existing program. Expressed per person achieving a 1% decrease in A1c, the ratio is $2,109.25. The corresponding cost-effectiveness ratios for creating a program *de novo* are substantially higher.

3.3.2 Sensitivity Analyses—The results of one-way sensitivity analyses are shown in Table 4. The wage paid to health educators exerts substantial influence on the cost-effectiveness ratios, regardless which numerator or denominator is being considered. Supervisor wages and price of telephone service have only minimal influence. Commercial space cost is not included in the calculation of the cost-effectiveness ratios compared to the print program, and therefore has no influence on those. However, the influence of commercial rent on the total cost effectiveness ratios is large and similar to that of the health educator wage.

The Monte Carlo sensitivity analysis allows for simultaneous variation in study outcomes and wage rates. Results are shown in Table 5. The upper reaches of the distribution of cost-effectiveness ratios are substantially higher than the worst case estimates in any of the one-way sensitivity analyses, because of the incorporation of uncertainty in the telephone intervention's effect on A1c outcomes. If intervention effectiveness is near the lower end of its 95% confidence interval, the denominators for the cost-effectiveness ratios approach zero, and the ratios themselves become large. Even so, with 95% certainty, the cost of adding the one-year telephone intervention to an existing program will not exceed $1552.23per percentage point A1c reduction.

4. Discussion

In summary, our telephone intervention was provided to 443 people from the South Bronx, a low-income and largely foreign-born population with poor baseline glycemic control (Walker et al., 2014, Chamany et al., 2015). The direct cost per patient was $187.61. Each percentage point of net A1c reduction was achieved at a direct cost of $464.41. Labor costs were the largest component of costs, and cost-effectiveness was most sensitive to the wages paid to the health educators.

There are few studies of similar interventions with which to compare the present study. Pillay et al. (2015) reviewed studies of behavioral interventions for patients with diabetes and report that the telephone was typically used to maintain contact or provide reminders. The remaining studies where the telephone was used to deliver a patient-support intervention generally do not report costs. The most comparable is the Improving Diabetes Outcomes (I DO) study (Walker et al., 2011, Schechter et al., 2012). The interventions and outcome measures and cost ascertainment methods are somewhat similar, although the study populations, eligibility criteria and intervention intensity were different. The incremental cost of the I DO study intervention was $180.61 per person and $490.58 per percentage point A1c improvement, whereas the current intervention cost $187.61 per person and $464.41 per percentage point A1c improvement. The higher efficiency of Bronx A1c is even greater than it appears in these figures because there has been 11% inflation between the 2009 I DO calculations and the 2013 Bronx A1c accounting. The differences are in part due to the greater A1c reduction in Bronx A1c (0.43 percentage points) vs I DO (0.36 percentage points). In addition, in the I DO study, the number of calls was not targeted to the baseline A1c level, and the average participant in the I DO study received 7.9 telephone calls. By contrast, in Bronx A1c, participants with lower initial A1c received fewer calls (4.6), so that the telephone calls were more concentrated on the group with initial A1c > 9, which also experienced the greatest improvements in A1c.

Nundy et al. (2014) carried out a non-randomized study of a mobile-phone based text-reminder and education intervention among diabetes patients enrolled in a health plan affiliated with University of Chicago Medicine, located in the largely low-income South Side neighborhood. As such, their population may be similar to ours. Similar to our study, the difference in mean pre-post glucose between study arms was 0.4% (favoring the intervention arm), quite close to the glycemic control effect seen in our study. Program costs, which they defined very similarly to our incremental costs, were estimated to be $375 per patient. This figure is already substantially larger than our incremental cost-per patient ratio, even though their intervention lasted only 6 months. Of great interest, they found that these costs were more than offset by savings due to reduced utilization in the intervention arm, resulting in a net saving of $437 per participant. We were not able to measure utilization in our study, but given the similar level of improvement in glycemic control achieved, similar patient population, and similar focus of the intervention on improving self-management behaviors, their findings give reason to believe that our intervention, too, may achieve net savings when downstream effects are reckoned.

Our study has several strengths. Economic analysis of the Bronx A1c project was contemplated from the beginning planning stages, and collection of the relevant cost data was carried out at the time of implementation. The study was a randomized controlled trial, and included stringent quality control of both intervention implementation and data collection. Another strength was the diverse, sample of study participants that included almost 70% foreign born, 56% Spanish speaking, and 77% reported an annual household income of <$20,000. (Walker et al., 2014)

Our study also has limitations. The perspective is that of a health services provider organization, not the societal perspective because it was not feasible to gather data on costs and savings incurred by the study participants. We also omitted from our analysis the costs of creating an electronic database with registry functionality: this type of infrastructure will be available in large health-care settings having electronic medical records and infrastructure for tracking, case management, and outreach. But it is a substantial cost that would be incurred by an organization not already having it. Our study capitalized on the existing A1c Registry created independently of our study by the NYC DOHMH.

In this telephonic intervention trial, we never had in-person contact with participants, and because we have no long-term follow-up, our effectiveness measures are intermediate outcomes. In addition, diabetes care management may also affect obesity, blood pressure, and lipids but we did not capture these effects in our study. The aggregate A1c change effectiveness measure treats two people each improving A1c by 0.5 percentage points as the equivalent of one person improving by 1 percentage point, and allows one person improving by 1 percentage point and another deteriorating by the same amount to "cancel each other out." Moreover, two people both improving by 1 percentage point are counted the same in this measure even if one started at 13% and the other at 7.5%. Some may find the numbers of persons achieving threshold levels of improvement to be more clinically meaningful measures of intervention effect. These outcomes, however, incorporate no offset for deterioration in glycemic control among other participants and treat any sub-threshold improvement as valueless.

The prevalence of missing end-of-study A1c outcomes in our study is another limitation. Although we expended considerable effort to remind patients to obtain an A1c within the window of eligibility for study inclusion and contacted their providers to obtain any A1cs that might not have reached the NYC A1c Registry, a more aggressive effort, perhaps in partnership with the providers, or providing specimen collection services ourselves might have led to more complete results.

Our intervention was focused on goal-setting and supporting the patients in achieving those goals. We did not explicitly deal with coexisting depression or diabetes-related distress. Encouraged by the results of the current study, the NYC DOHMH and Albert Einstein

College of Medicine are now conducting a clinical trial of a telephone based intervention that focuses on these psychological aspects of diabetes care.

Another limitation is that we do not currently have access to information about health care utilization, which may have been affected by the intervention. As we have reported elsewhere (Chamany et al., 2015), medication regimens were similar in both study arms at baseline and the intervention did not affect changes made to medications during the study. Our intervention may have affected medication adherence, although we found no evidence of this with our participant self-report measures. And we cannot exclude the possibility that other aspects of health care utilization were affected.

5. Conclusions

With this study we have confirmed that telephonic self-management support can be efficiently and effectively delivered by supervised, trained health educators. It could be efficiently adopted by large health care systems or public health departments having adequate information technology infrastructure as an enhancement to existing diabetes self-management support programs, or, at greater cost, as a *de novo* program.

Moreover, the comparison between our present findings and those of the I DO study suggest that varying the intensity of support provided based on initial level of glycemic control resulted in both lower cost and increased effectiveness for the participants with poor glycemic control. Additional research, particularly to learn whether intervention effects persist over the long term, and to determine the long run impact on diabetes complications is needed, as is further investigation of appropriate interventions for those with better, but suboptimal glycemic control.

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Table 1

Parameters of One-Way Sensitivity Analysis

		One-Way Sensitivity Analysis	
Parameter	**Base Case**	**Best Case**	**Worst Case**
Health Educator Hourly Wage[1]	$23.66	$17.74	$32.43
Supervisor Wages[2]			
Nurse Certified Diabetes Educator	$38.55	$28.91	$50.12
Clinical Psychologist	$32.58	$24.43	$42.36
Internist	$89.83	$67.37	$116.79
Cost per minute of telephone time	$0.05	$0.02	$0.075
Commercial Rent (per sq ft per year)	$23.23	$10.80	$49.98

Notes:

[1] Best and worst case values are 25th and 75th percentiles of distribution.

[2] Best and worst case values for the nurse CDE are 75% and 130% of base case values, respectively. In this one-way sensitivity analyses, the wages of the nurse CDE, clinical psychologist and internist were varied together, and the clinical psychologist and internist wages are varied in proportion to that of the nurse CDE.

Table 2

Costs of Intervention

Category/Item	Quantity	Cost (US$)	Totals
LABOR			
Completed Calls	1,542.90 Hours	47,456.40	
Incomplete Calls	122.25 Hours	3,760.17	
Supervision (Health Educators)	480.00 Hours	14,763.84	
Supervision (RN CDE Supervisor)	120.00 Hours	6,013.80	
Consultative supervision (Psychologist)	48 Hours	2032.99	
Consultative supervision (Internist)	48 Hours	5,605.39	
			79,632.58
TELEPHONE CHARGES			
Completed Calls	68,093.8 Minutes	3,404.69	
Incomplete Calls	1,467 Attempts	73.35	
			3,478.04
PRINT MATERIALS (incl. mailing costs)			
	941 Participants	12,468.28	**12,468.28**
INCENTIVES (incl. mailing costs)			
Pedometers	941	20,240.91	
Insulated Lunch Bags	941	6,191.78	
7-day Pill Boxes	941	2,446.60	**28,879.29**
DURABLE EQUIPMENT			
Work Stations	6	20,324.88	
Shredder	1	431.21	
Security Equipment & Installation	N/A	12,655.33	
Filing Cabinets	1	839.56	
Fax Machine & Copiers	3	2406.97	
Desk Chairs	6	3,900.00	
			32,446.36
OFFICE SPACE	240 sq ft	22,300.80	**22,300.80**
DIRECT COSTS OF TELEPHONE & LABOR			**83,110.62**
TOTAL EXCLUDING PRINT MATERIALS AND INCENTIVES*			**140,777.96**
GRAND TOTAL			**185,846.81**

Table 3

Program Effects and Cost-Effectiveness Ratios – Base Case Analysis

		Result per 100 Participants			Cost-Effectiveness Ratio (US$/Unit Outcome)	
Outcome	**Unit**	**Pr Only (N = 498)**	**Tele/Pr (N = 443)**	**Difference**	**Compared to Print Program**	**Compared to No Program**
A1c Reduction	%age Points	43.04	84.37	41.33	464.41	1038.49
A1c Improving ≥ 1 %age Point	Persons	28.33	37.43	9.10	2,109.25	4,716.56
A1c Improving ≥ 0.5 %age Points	Persons	39.44	50.30	10.86	1767.42	3952.19

Table 4

One-Way Sensitivity Analyses

Program Input[1]	Price (US $)	Cost-Effectiveness Ratio Compared to Print Program				Cost-Effectiveness Ratio Compared to No Program			
		Per Patient	A1c Reduction	A1c Improving ≥ 1 %age Point	A1c Improving ≥ 0.5 %age Point	Per Patient	A1c Reduction	A1c Improving ≥ 1 %age Point	A1c Improving ≥ 0.5 %age Point
Educator Wage	17.74	150.34	372.16	1690.24	1416.32	382.25	946.23	4297.56	3601.09
	32.43	242.81	601.07	2729.91	2287.49	474.72	1175.15	5337.23	4472.26
Supervisory Wages[2]	28.91	179.90	445.33	2022.59	1694.80	411.81	1019.41	4629.91	3879.57
	50.12	196.86	487.30	2213.20	1854.53	428.77	1061.38	4820.52	4039.30
Telephone (per min.)	0.02	182.90	452.75	2056.29	1723.04	414.81	1026.83	4663.60	3907.81
	0.075	191.53	474.13	2153.38	1804.40	423.44	1048.21	4760.70	3989.17
Commercial Rent (per sq ft)	10.80	187.61	464.41	2109.25	1767.42	392.58	971.81	4413.73	3698.43
	49.98	187.61	464.41	2109.25	1767.42	477.49	1181.99	5368.29	4498.29

Notes:

[1] For the selected program inputs, we show two analyses. The upper row reflects a best-case scenario, and the lower row, a worst-case scenario.

[2] In the sensitivity analysis for supervisory wages, the wages of the nurse certified diabetes educator, clinical psychologist, and internist are varied simultaneously, applying the same ratio compared to their base case values. To save space and enhance table readability, the values shown in the Price column of this table are those for the nurse certified diabetes educator. Table 2 shows the corresponding values for the clinical psychologist and internist.

Table 5

Probabilistic Sensitivity Analysis

Outcome	Cost-Effectiveness Ratio Compared to Print Program				Cost-Effectiveness Ratio Compared to No Program			
	Median	75^{th} %ile	90^{th} %ile	95^{th} %ile	Median	75^{th} %ile	90^{th} %ile	95^{th} %ile
Patients Served	187.46	194.80	201.42	205.26	419.37	426.71	433.33	437.17
A1c Reduction	489.40	691.29	1077.12	1552.23	1093.74	1545.67	2411.68	3467.85
A1c Improving ≥ 1 %age Point	2058.88	2805.26	4111.71	5572.37	4601.24	6281.47	9181.72	12457.77
A1c Improving ≥ 0.5 %age Point	1726.10	2264.41	3127.58	4042.59	3863.25	5059.78	6955.67	9027.52