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Cost of a Group Translation of the Diabetes Prevention Program:

Healthy Living Partnerships to Prevent Diabetes

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Abstract

Background—Although numerous studies have translated the Diabetes Prevention Program lifestyle intervention into various settings, no study to date has reported a formal cost analysis.

Purpose—To describe costs associated with the Healthy Living Partnerships to Prevent Diabetes (HELP PD) trial.

Design—HELP PD was a 24-month RCT testing the impact of a lifestyle weight-loss intervention administered through a diabetes education program and delivered by community health workers (CHWs) on blood glucose and body weight among prediabetics.

Setting/participants—In all, 301 participants with prediabetes were randomized in Forsyth County NC. Data reported in these analyses were collected in 2007–2011 and analyzed in 2011–2012.

Intervention—The lifestyle weight-loss group had a 7% weight loss goal achieved and maintained by caloric restriction and increased physical activity. The usual care group received two visits with a registered dietitian and monthly newsletters.

Main outcome measures—Measures are direct medical costs, direct nonmedical costs and indirect costs over the 2-year study period. Research costs are excluded.

Results—The direct medical cost (in 2010 dollars) to identify one participant was $16.85. Direct medical costs per capita for participants in the usual care group were $142 and $850 for lifestyle weight-loss participants. Per capita direct costs of care outside the study were $7454 for the usual care group and $5177 for the lifestyle weight-loss group. Per capita direct nonmedical costs were $12,881 for the usual care group and $13,836 for the lifestyle weight-loss group. The lifestyle weight-loss group in HELP PD cost $850 in direct medical costs for 2 years, compared to $2631 in direct medical costs for the first 2 years of DPP.

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Conclusions—A community-based translation of the DPP can be delivered effectively and with reduced costs.

Introduction

The Diabetes Prevention Program (DPP) and the Finnish Diabetes Prevention Study (FDPS) demonstrated that a lifestyle weight-loss intervention can delay or prevent the progression from impaired glucose tolerance to type 2 diabetes.[1-3] However, the high costs associated with the DPP lifestyle intervention represent a substantial barrier to widespread dissemination and implementation.[4] Herman[3] reported a per capita direct medical cost over 3 years of the DPP lifestyle intervention of $2780 per participant in 2000 dollars, and $3519 per participant in 2010 dollars. This was likely due to the specialized personnel required and the individualized approach used to deliver the intervention. Consequently, a number of attempts have been made to translate the DPP using approaches that reduce costs and maintain effectiveness, primarily community-based settings and group-based delivery.[5,6]

A recent meta-analysis reviewed various attempts to translate the DPP lifestyle intervention.[5] Significant weight-loss effects were found at 12 months of follow-up for each category: medical and allied health professionals, −4.27 kg; lay community members, −3.15 kg; electronic media–assisted, −4.20 kg; overall mean = −3.99 kg. Similarly, Whittemore[6] also reviewed diabetes prevention translational studies and included estimates of intervention costs, reporting estimated 1-year costs including $300 per participant,[7] $275–$325 per participant,[8] and $108 per participant.[9] However, the costs reported were rough estimates, and no translational study to date has reported a rigorous cost analysis designed to be directly compared to the DPP costs.[6]

The current analysis reports the cost of the Healthy Living Partnerships to Prevent Diabetes (HELP PD) study, a community-based translation of the DPP. HELP PD translated the DPP trial by using fasting glucose to determine eligibility, delivering the lifestyle intervention in a group setting, implementing the intervention through a local diabetes education program, and delivering it using community health workers (CHWs). The HELP PD design, recruitment methods, and outcomes have been described in detail elsewhere.[10-13] HELP PD resulted in reduced fasting blood glucose (−4.35 mg/dL) and body weight (−4.19%) relative to usual care participants at 2 years.[13] Here, the costs participants experienced during the HELP PD trial are reported.

The cost analyses performed for HELP PD closely follow the methods and details of the DPP cost study,[3] which, in the authors' judgment represent good practice and present the results in a manner that makes them most comparable to those of the DPP researchers. The only variation from the methods of the DPP trial is the use of primarily mean values instead of median values. Mean values are preferred by researchers in the field of economic trials alongside RCCTs because the values can be used in parametric estimation techniques.[14] These techniques have become standard in the literature on the cost effectiveness of clinical trials and will aid in the future cost-effectiveness analysis planned for the HELP PD trial. When reporting direct nonmedical costs related to HELP PD, some "trimmed" means are reported in an effort to eliminate extreme outlier values that may be the result of reporting errors or chance events that are unlikely to be repeated in practical settings. Otherwise, every attempt has been made to adhere to the techniques used in the DPP economic analyses.

Methods

Briefly, HELP PD randomized 301 overweight or obese (25< BMI >40) participants with elevated fasting blood glucose indicating prediabetes, to either a DPP-based lifestyle weight-

loss group (lifestyle group) or an enhanced usual care comparison group (usual care group). All participants provided written informed consent prior to screening. This study was reviewed and approved by the IRB of Wake Forest University Health Sciences. Participants in both treatment groups were seen every 6 months to collect outcome data. At baseline, the mean age of the participants was 57.9 (SD=9.5) and the mean BMI was 32.7 (SD=4.0). Of the participants, 57.5% were female, 73.8% were Caucasian, and 24.6% were African-American; 17.9% were both female and African-American.[11] There were no differences between the lifestyle and the usual care groups at baseline.[10-13]

The lifestyle group intervention was administered through a diabetes education program (DEP) and delivered by community health workers (CHWs). Registered dietitians (RDs) employed by the DEP trained, monitored, and supported the CHWs, who were community members with well-controlled diabetes. The CHWs led the lifestyle groups, managed participants, and collected attendance data.

The goal for participants assigned to the lifestyle group was to achieve and maintain a weight reduction of at least 7% of initial body weight through a healthy, low-calorie diet and moderate-intensity physical activity, primarily brisk walking, for at least 180 minutes per week. The initial 6 months (Phase 1) of the trial involved weekly group meetings and three individual sessions with a registered dietitian. In Phase 2 (Months 7–24), group meetings were held monthly. The enhanced usual care group was designed to exceed the level of care routinely provided to patients with prediabetes and was comprised of two individual sessions with a nutritionist during the first 3 months and a monthly newsletter.

All costs reported here are based not on the study protocol, but on actual participant attendance and include the direct medical costs, direct nonmedical costs, and indirect costs of both the usual care and the lifestyle groups. Data reported in these analyses were collected in 2007–2011, and the analyses were conducted in 2011–2012. Costs were calculated by applying unit costs to the resources reported by subjects. Unit costs were multiplied by the quantity of resources used, as reported by subjects.[15] Any costs or resources that were research-related were excluded. All costs are adjusted to 2010 U.S. dollar values using the consumer price index.[16] The analysis refers to the 2year time horizon which was the time period during which the HELP participants were followed.

Categories of Costs and Perspectives Assumed in Cost Analyses

Estimates of direct medical costs were based on the number of fasting glucose assays needed to identify one subject with prediabetes (blood glucose level between 95 and 125 mg/dL) and the dollar value of implementing that test. Additionally, direct medical costs include the value of resources associated with delivery of the lifestyle and usual care arms and the value of care avoided by study subjects. This aspect of direct medical cost was captured by participant report via forms administered at 6, 12, 18, and 24 months, adverse event reports, and publicly available sources on the costs of care outside the HELP PD study (e.g., the average cost of care delivered in an MD office visit, the average cost of a stay in a hospital room). In HELP PD, direct nonmedical costs included the value of the participants' time used in activities such as exercising, shopping and cooking, the value of exercise classes, exercise equipment, food preparation items, and the costs of transportation to and from activities. This information was collected via questionnaire administered to participants during assessments at 6, 12, 18, and 24 months.

Indirect costs are costs due to morbidity and mortality.[15] Indirect morbidity costs are due to not attending work because of medical treatment. Indirect mortality costs are due to decreased lifetime income arising from premature death.

The analyses reported here are designed to report cost from two separate perspectives. The first is cost as seen by a healthcare system, such as an insurance or hospital system. The health system perspective represents the expenditure needed to identify a prediabetic patient, the direct medical costs of the intervention, and the cost of care utilized and/or avoided through participation in the trial. The second perspective, that of society, represents the cost from the perspective of a healthcare system plus any extra nonmedical costs of participants, the value of resources used by participants, the value of participant time, and the costs of participant' morbidity and mortality (an estimate of the indirect cost).

Results

Direct Medical Cost of Identifying Individuals with Impaired Fasting Glucose

The costs of identifying participants with prediabetes in HELP PD are found by considering the cost of the laboratory test used and the number of tests needed to identify one participant as prediabetic. Individuals who were at risk for developing diabetes were identified using a fasting plasma glucose test in HELP PD. The rationale for choosing this test (a variation from the DPP study) was that the test is more routinely encountered in clinical settings, is less time-consuming to administer compared to a glucose tolerance test, and is substantially less expensive than that test. The direct medical cost of identifying participants is presented in Table 1 and is based on the 746 individuals who met all other eligibility criteria for participation.[11] Each test cost $6.80, and 301 individuals were identified with impaired fasting glucose, resulting in a mean cost per qualifying participant identified in the HELP PD trial of $16.85.

Direct Medical Costs of Treatment Groups

As part of estimating the direct medical costs of the two treatment groups in the HELP PD, study personnel completed a questionnaire every 6 months, detailing the type, frequency, and duration of participant encounters. Unit costs for personnel are based on the mean institutional salary for that position plus a fringe rate of 35%. Unit costs for study materials and newsletters do not include the costs of developing these materials, and for the lifestyle group, do include all materials provided to participants during the intervention, including pedometers, scales, workbooks, and DVDs.

For sessions for the lifestyle group, units of time needed to accomplish a task per participant were calculated as the mean number of sessions attended per participant divided by the mean number of expected participants at each session. CHWs were compensated at a rate of $100.00 per week in Phase 1 and $200.00 per month in Phase 2. They were also asked to report the amount of time used in preparing for and recording the results of each session working on HELP PD. In order to estimate a unit cost for CHW-led lifestyle intervention sessions, the amount paid was divided by the mean hours reported per week (Phase 1) or per month (Phase 2). For sessions for the lifestyle group that involved attendance by study staff, units were calculated based on the total number of group sessions attended by staff divided by the number of participants randomized to the lifestyle condition.

For PRN visits with either the RD or exercise specialist, a per capita unit was calculated by dividing the total number of PRN visits conducted by the number of participants who had at least one PRN visit. Total cost for each category was calculated by multiplying the units of a particular resource used by the percentage of participants that reported using that resource, the frequency with which participants reported using that resource, and the unit cost of that resource (per hour, or per unit). The study "toolbox" was used to provide assistance to participants who were struggling to meet study goals and to enhance retention and

adherence. Overhead costs were estimated at 48%, based on Wake Forest School of Medicine's rate as negotiated with the NIH.

Table 2 reports mean values of per capita costs for Years 1–2 for participants who were randomized to the usual care group. The total per capita direct medical cost for HELP PD participants over the entire 2-year duration of the trial in the usual care group was $142. Table 3 reports direct medical costs incurred by HELP PD participants in the lifestyle group for Phases 1 and 2 of the study and for the entire duration of the study. These varied considerably between the initial intensive (Phase 1) and subsequent maintenance phase (Phase 2) of the study, from $568 to $282 per year. The total per capita direct medical cost over the 2 years of the trial in the lifestyle group was $850.

Direct Medical Costs of Care Outside Healthy Living Partnerships to Prevent Diabetes

The per capita direct medical costs of care outside HELP PD for both treatment groups were derived from participant reports of adverse medial events during the study. Records of care reported by caregivers during episodes of serious adverse events were reviewed by an MD to adjudicate between study-related care and care not related to participation in the study. Also, participants were surveyed on their use of hospital emergency rooms, outpatient procedures, other outpatient visits, and prescription medications.

Each reported hospitalization was assigned a cost using national information for each category of care using costs from the Health Care Utilization Project.[17] The per capita number of hospital days was calculated by dividing the total number of hospital days reported in each treatment group by the number of participants in that treatment group. The median national charge and mean physician fee for each reported hospitalization were summed and then divided by the number of days hospitalized to calculate a daily cost for each event. These daily costs were then averaged for each treatment group to determine the unit cost of a single hospital day by treatment group. This unit cost was then multiplied by the per capita days of hospitalization for that treatment group to determine the per capita cost.

Unit costs were calculated based on median national facility charges and mean national physician fees for emergency room visits, outpatient visits, and outpatient procedures. The sum of the median national cost and the physician fee was used to calculate a unit cost (Appendix A). The per capita number of visits was calculated by dividing the number of each type of visit in each treatment group by the number of participants in that treatment group. Per capita cost was calculated by multiplying the per capita visits by the unit cost.

As in DPP, the cost of prescription medications was calculated by assigning a unit cost to medications reported by at least 5% of study participants based on the price for a 6-month prescription from an Internet pharmacy (Appendix A shows sources from which unit retail prices of medications are derived). Medications were grouped according to generic name, and all medications were included, regardless of their purpose or the condition being treated. Medications used by less than 5% of study participants were assigned a cost of $0, and data on medication use were collected at study visits every 6 months. All visits were averaged to estimate the cost that each participant spent on medications for a 6-month interval. The median cost of medication for 6 months was then calculated within each treatment group and multiplied by four (the number of participant visits at which medication use was reported) to get the per capita cost of medications over 2 years.

Table 4 reports values for per capita direct medical costs of care outside HELP PD in total for each group and marginally for the lifestyle group compared to the usual care group. The lifestyle group costs were lower in four of five categories of care outside the study. The

usual care group spent slightly less for emergency room visits, with a per capita cost of $57, compared to the $71 in the lifestyle group. Overall, the amount spent per capita on care outside the study was significantly lower in the lifestyle group ($5177 vs $7454).

Direct Nonmedical Costs

To estimate direct nonmedical costs, the measures reported here are: the average time spent by participants in various study-related activities; information on out-of-pocket purchases related to healthy living; and changes in the cost of food since enrolling in the study. For services and products purchased by participants, only those reported by at least 5% of participants were included. The analyses are based on the assumption that all items were purchased once during the 2-year study period except for the following: exercise shoes (two pairs per year for lifestyle participants and one pair per year for usual care group participants); exercise classes (1 week per participant); and commercial weight-loss programs (1 month per participant). It was also assumed here, with the DPP researchers, that durable equipment (any equipment that had an initial purchase price of more than $100 and that would last more than 2 years) could be resold for "50% of the purchase price after 2 years."[3] All of the assumptions defined in this paragraph were the same as those employed by the DPP researchers.[3]

As the HELP PD intervention was designed to encourage participants to exercise more, great effort was made to evaluate the economic value of exercise to individuals in the current trial. Consequently, participants were asked every 6 months about their attitude toward exercise. Participants could report whether they "liked, disliked or were neutral" toward exercise. Participants were also asked to complete the International Physical Activity Questionnaire (IPAQ) every 6 months in order to estimate the amount of time spent in moderate and vigorous exercise.[18]

Time reported as spent in exercise for each participant was then weighted based on their attitude toward exercise. For those who "like" exercise, time in exercise was valued as $0; for those who felt "neutral" about exercise as one quarter of the mean hourly wage in the U.S. for 2010 ($5.33) and for those that reported that they "dislike" exercise as one half the mean hourly wage in the U.S. for 2010 ($10.65).[19] Average hours spent exercising and weighted cost of exercise were calculated for each participant, and extreme outliers were removed. Both averages were then calculated for the lifestyle and usual care groups. Time spent by HELP PD participants in self-monitoring and in cooking food was valued with a single per-hour unit cost for both groups in the HELP PD study ($5.33, one quarter of the mean hourly U.S. wage in 2010).

Table 5 reports the per capita direct nonmedical costs and the difference in this cost between the two arms. Time reported as spent exercising was higher in the intervention group compared to the usual care group. Reported time spent by participants doing shopping and cooking was somewhat higher in the usual care group. Time spent self-monitoring health was substantially higher in the lifestyle group. There was little influence on total direct nonmedical costs from time spent exercising between the two groups due to the enjoyment of exercise reported by both groups and the resulting weighting of exercise according to attitudes toward that activity. This is mostly due to participants in the lifestyle group and the usual care group displaying an almost equally positive attitude toward exercise. In total, direct nonmedical costs of participants' time spent shopping, exercising or self-monitoring was $595 higher for the lifestyle group than for the usual care group.

Both groups spent about the same amount of money on services, fitness and food equipment, and food away from home. The intervention group spent a considerably greater amount than

the usual care group on transportation ($270). Summing all categories of direct nonmedical costs, the intervention group outspent the usual care group by $955 per person.

Indirect Costs in Healthy Living Partnerships to Prevent Diabetes

Indirect costs are the cost of time that participants reported as missing from normal functions because of visits, illness, injury or death. The indirect cost in the two arms of HELP PD is reported as both equal to $0 for two reasons. First, the indirect costs of mortality cannot be reported because no participants in HELP PD died during the study period. In addition to this, participants were not asked to report missed days of school, work, or routine activities, so the indirect costs due to morbidity cannot be calculated.

Table 6 summarizes the per capita cost differences across study arms over the 2 years for which the trial was conducted. “From the perspective of a large health system, which would pay only direct medical costs,”[3] the cost of the lifestyle intervention over 2 years, compared to the usual care group in HELP PD, was $1569 less. “From the perspective of society, which would pay direct-medical, direct-nonmedical and indirect costs,”[3] the cost of the lifestyle intervention, compared to the usual care group, was $614 less.

Discussion

The purpose of the present study was to formally report the costs associated with the HELP PD lifestyle intervention using the methods utilized in the DPP. In HELP PD, the lifestyle intervention was more expensive than was the direct cost of care in the usual care group ($850 vs $142 for 2 years). The majority of the rest of the cost of the lifestyle intervention can be accounted for by more direct medical costs attributed to staff time used in delivering the intervention and direct nonmedical cost attributed to participant time spent exercising, preparing food, and traveling. The lifestyle participants experienced significant and meaningful declines in fasting blood glucose, insulin, body weight, waist circumference, and BMI relative to the usual care participants.[12,13]

The cost of identifying prediabetics by administering a blood glucose test and delivering the HELP PD lifestyle intervention represented only 14% of total direct medical costs for that group ($866.85/$6043.85), as direct medical costs also included the cost of medical care outside the HELP PD study. The latter varies with chance health events and any changes in health derived from participating in HELP PD. There were differences in the costs of care received outside of HELP PD among the two arms of the study. Participants in the lifestyle arm reported fewer per capita hospitalization days, and the cost associated with the care received for each specific event was lower than the costs for the usual care group.

To fully explore the role of direct nonmedical costs in the HELP PD study, the authors recorded in detail participants’ use of resources and calculated the associated costs. Subjects in the lifestyle and usual care groups reported similar total direct nonmedical costs. Lifestyle participants reported spending more hours exercising and monitoring their activity and diet behaviors than did usual care participants. Alternatively, usual care subjects reported spending more time performing tasks related to shopping and cooking.

Somewhat surprisingly, subjects in both groups reported liking exercise during the course of the HELP PD study (the cumulative percentage of HELP participants that ever reported that they “like” exercise was 89% in the lifestyle group and 94% in the usual care group). Thus, the “adjusted” costs of exercise reported in Table 5 may substantially devalue the time spent exercising in both groups. The biggest difference between the two groups is that subjects in the lifestyle group reported spending substantially more time traveling than did subjects in

the usual care group. Surprisingly, both groups spent about equal time preparing and cooking food.

When comparing the total per capita direct medical cost for the first 2 years of the DPP lifestyle intervention with that of the HELP PD lifestyle intervention in 2010 dollars, the DPP intervention is much costlier. The total per capital direct medical cost of the lifestyle intervention in HELP PD was $850, less than one third of the $2631 reported for Years 1–2 in the DPP lifestyle intervention. This is due primarily to two factors. First, the HELP PD lifestyle intervention was delivered on a group basis, instead of the individual basis of delivery in the DPP study. Second, the lifestyle intervention groups were led by CHWs. These CHWs were lay volunteers recruited by local physicians providing routine care for diabetes patients from the target population and were only nominally paid. The DPP study relied on more-costly medical professionals to deliver its lifestyle intervention.

The HELP PD study showed that the DPP could be translated effectively to a community setting via a partnership between registered dietitians and CHWs. As noted, Whittemore reported the costs of three DPP translational studies ranging from $108 to $300 per participant per year.[6] However, since no translational studies to date have reported formal cost analyses, it is difficult to compare these values to the present study. To our knowledge, this is the first DPP translational study to report a formal cost analysis comparable to the methods used in DPP.[3]

Overall, the HELP PD lifestyle intervention achieved significant and meaningful long-term reductions in markers associated with type 2 diabetes, including fasting blood glucose (−4.35 mg/dl) and body weight (−4.59 kg), that are quite comparable to the results of the DPP.[12,13] Although the present study was not powered to detect significant reductions in diabetes incidence, the reductions in blood glucose achieved in HELP PD are approximately equal to those achieved in the DPP (−4 mg/dl),[1] suggesting that this may be a powerful approach to widespread diabetes prevention. Moreover, the HELP PD lifestyle group had substantially lower direct medical costs; the lifestyle intervention over 2 years was just 32% of the cost of the DPP lifestyle intervention over 2 years. Thus, this study fulfills a hope expressed by the DPP researchers when they wrote that “it is also likely that cost of the lifestyle intervention could be reduced by improving the efficiency of utilization of staff time by using group visits.”[3]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Knowler WC, Barrett-Connor E, et al. Diabetes Prevention Program Research Group Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Eng J Med. 2002; 346(6):393–403.
2. Tuomilehto J, Lindström J, Eriksson JG, et al. Finnish Diabetes Prevention Study Group Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. N Eng J Med. 2001; 344(18):1343–50.
3. Herman WH, Brandle M, Zhang P, et al. Diabetes Prevention Program Research Group Costs associated with the primary prevention of type 2 diabetes mellitus in the diabetes prevention program. Diabetes Care. 2003; 26(1):36–47. [PubMed: 12502656]
4. Garfield SA, Malozowski S, Chin MH, et al. Considerations for diabetes translational research in real-world settings. Diabetes Care. 2003; 26:2670–4. [PubMed: 12941736]
5. Ali MK, Echouffo-Tcheugui JB, Williamson DF. How effective were lifestyle interventions in real-world settings that were modeled on the diabetes prevention program? Health Affairs. 2012; 31(1): 67–75. [PubMed: 22232096]
6. Whittemore R. A systematic review of the translational research on the Diabetes Prevention Program. Translational Behav Med. 2011; 1(3):480–91.
7. Kramer MK, Kriska AM, Venditti EM, et al. Translating the Diabetes Prevention Program: a comprehensive model for prevention training and program delivery. Am J Prev Med. 2009; 37(6): 505–11. [PubMed: 19944916]
8. Ackermann RT, Finch EA, Caffrey HM, Lipscomb ER, Hays LM, Saha C. Long-term effects of a community-based lifestyle intervention to prevent type 2 diabetes: the DEPLOY extension pilot study. Chronic Illn. 2011 Aug 12. Epub ahead of print.
9. Davis-Smith YM, Boltri JM, Seale JP, Shellenberger S, Blalock T, Tobin B. Implementing a diabetes prevention program in a rural African–American church. J Natl Med Assoc. 2007; 99(4): 440–6. [PubMed: 17444435]
10. Katula JA, Vitolins MZ, Rosenberger EL, et al. Healthy Living Partnerships to Prevent Diabetes (HELP PD): design and methods. Contemp Clin Trials. 2010; 31(1):71–81. Epub 2009 Sep 13. [PubMed: 19758580]
11. Blackwell CS, Foster KA, Isom SP, Vitolins MZ, Rosenberger EL, Goff DC Jr. Healthy Living Partnerships to Prevent Diabetes: recruitment and baseline characteristics. Contemp Clin Trials. 2011; 32:40–49. [PubMed: 20974289]
12. Katula JA, Vitolins MZ, Rosenberger EL, et al. One-year results of a community-based translation of the Diabetes Prevention Program: Healthy-Living Partnerships to Prevent Diabetes (HELP PD) Project. Diabetes Care. 2011; 34:1451–7. [PubMed: 21593290]
13. Katula JA, Vitolins MZ, Morgan T, Lawlor MS, Blackwell C, Goff DC Jr. The Healthy Living Partnerships to Prevent Diabetes (HELP PD) Study: 2-year effects on fasting blood glucose, insulin, and adiposity. Am J Prev Med. In press.
14. Glick, HA.; Doshi, JA.; Sonnad, SS.; Polsky, D. Economic Evaluation in Clinical Trials. Oxford: Oxford University Press; 2007.
15. Gold, MR.; Siegel, JE.; Russell, LB.; Weinstein, MC. Cost-effectiveness in health and medicine. New York: Oxford University Press; 1996.
16. Consumer price index and medical consumer price index. www.economagic.com/blscu.htm
17. HCUPnet. Agency for Healthcare Research and Quality. Rockville MD: Healthcare Cost and Utilization Project. hcupnet.ahrq.gov/
18. Craig CL, Marshall AL, Sjostrom M, et al. International physical activity questionnaire: 12-country reliability and validity. Medicine Science Sports Exercise. 2003; 35(8):1381–95.
19. National compensation survey: occupational wages in the U.S. 2010. www.bls.gov

Table 1

Per capita direct costs of identifying individuals with impaired fasting glucose

	2007	2008	2009	Total
Participants tested (*n*)	234	408	104	746
Those tested who were randomized (*n*)	98	163	40	301
Cost per test ($)	6.8	6.8	6.8	6.8
Cost per individual identified ($)	16.24	17.02	17.68	16.85

Note: The unit cost per test is based on the 2010 Medicare Laboratory Fee Schedule.

Table 2

Per capita direct medical costs of the Healthy Living Partnerships to Prevent Diabetes usual care condition

	Provider	Units[a]	Subjects (%)	Time (hours)[b]	Unit Cost ($)	Total Cost ($)[c]
1st-visit counseling	RD	0.95	100.0	1.00	30.77	29
Materials		1.00	100.0		21.15	21
2nd-visit counseling	RD	0.82	100.0	0.75	30.77	19
Monthly Newsletter		24.00	100.0		1.73	42
Reminder Calls	RD	2.00	99.5	0.08	32.00	5
Overhead (48% of personnel)						26
Total Cost (Years 1 and 2)						142

[a]Units calculated a total number of sessions completed or materials distributed divided by the total number of participants in the usual care condition group.

[b]Time represents the portion of 1 hour needed to provide one unit of each resource.

[c]Total cost per participant is arrived at by multiplying “units”, “subjects”, “time”, and “unit cost.”

RD, registered dietician

Table 3

Per capita direct medical costs of the Healthy Living Partnerships to Prevent Diabetes lifestyle intervention

Phase 1 (Intensive Phase)						
	Provider	**Units[a]**	**Subjects (%)**	**Time (hours)[b]**	**Unit Cost ($)**	**Total Cost ($)[c]**
Lifestyle Group Sessions	CHW	1.94	100.0	8.15	12.27	194
Materials		1.00	100.0		120.82	121
RD-Attended Group	RD	0.46	100.0	1.92	30.77	27
ES-Attended Group	ES	0.19	100.0	1.25	26.93	6
Individual Nutrition	RD	3.00	100.0	1.28	30.77	118
PRN RD Sessions	RD	2.24	22.5	0.67	30.77	10
PRN Exercise Specialist	ES	1.00	6.0	0.50	26.93	1
Reminder Calls	RD	3.00	99.5	0.08	30.77	7
Reminder e-mails	RD	3.00	5.5	0.15	30.77	1
Toolbox						1
Overhead (48% of						82
Total Cost (Months 1–6)						568
Phase 2 (Maintenance Phase)						
Lifestyle Group Sessions	CHW	1.02	100.00	18.1	11.05	204
Materials		1.00	100.0		19.23	19
PRN RD sessions	RD	1.98	33.11	0.67	30.77	14
PRN Exercise Specialist	ES	1.44	10.60	0.5	26.93	2
Tool Box						36
Overhead (48% of						7
Total Cost (Months 7–24)						282
Total Cost (Years 1–2)						850

[a]For lifestyle group sessions, units calculated as average number of sessions attended divided by the average number of expected participants at each session. For RD- and ES-attended group sessions, units were calculated as: total number of group sessions attended /total number of participants in the lifestyle group. For all other resources, units were calculated as total number of sessions completed or materials distributed divided by the total number of participants in the lifestyle group.

[b]Time represents the portion of 1 hour needed to provide one unit of each resource.

[c]Total cost per participant is arrived at by multiplying “units”, “subjects”, “time”, and “unit cost.”

CHW, community health worker; ES, exercise specialist; PRN, RD, registered dietician;

Table 4

Per capita direct medical cost of care outside HELP PD by treatment group, Years 1–2

	Lifestyle condition	Lifestyle condition Cost[a] ($)	Usual care condition	Usual care condition Cost[a] ($)	Lifestyle condition vs usual care condition ($)[b]
Hospital Days	0.22	4778	0.56	6994	−2216
Emergency Room Visits	0.10	71	0.08	57	14
Outpatient Procedures	0.05	43	0.08	69	−26
Other Outpatient Visits	0.09	47	0.13	68	−21
Prescription Medications		238		266	−28
Total		$5177		$7454	−$2277

Note: The “lifestyle” condition is the lifestyle weight-loss condition.

[a]The unit cost of a hospital day was calculated by summing the median national facility charge and mean national physician fee for each specific event and then dividing by the number of days the participant was hospitalized for that event.

[b]Cost for participants in each group is the product of the per capita use of that resource (lifestyle condition vs usual care condition) multiplied by the unit cost of that resource (Appendix A).

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Table 5

Per capital direct nonmedical costs by treatment group, Years 1–2

	Lifestyle condition time	Lifestyle condition Costs ($)	Usual care condition time	Usual Care condition Costs ($)	Lifestyle condition – usual care condition ($)
Participant time					
Adjusted exercise[a]	350 hours	242	261 hours	158	84
Shopping and cooking	579 hours	3086	626 hours	3337	−251
Self-Monitoring	225 hours	1199	82 hours	437	762
Subtotal		4527		3932	595
Services					
Exercise classes	31	3	29	3	0
Health club	42	43	42	43	0
Commercial Weight	8	3	16	6	−3
Loss Program					
Subtotal		49		52	−3
Fitness equipment					
Bicycle	11	25	13	30	−5
Exercise videos	42	4	34	4	0
Free weights	38	8	38	8	0
Home gym	9	75	10	84	−9
Stationary bicycle	9	26	16	46	−20
Step (for aerobics)	6	4	6	4	0
Tennis racquet	6	5	6	5	0
Treadmill	17	176	13	135	41
Exercise Ball	6	1	5	1	0
Wii	6	9	8	13	−4
Subtotal		333		330	3
Food equipment					
Air Popper	9	2	3	1	1
Blender	28	11	30	12	−1

	Lifestyle condition time	Lifestyle condition Costs ($)	Usual care condition time	Usual Care condition Costs ($)	Lifestyle condition – usual care condition ($)
Cookbooks	59	8	53	7	1
Cooking videos	9	2	3	1	1
Freezer	10	27	8	21	6
Microwave	14	14	8	8	6
Mixer	11	6	12	6	0
Steamer	18	5	17	5	0
Wok	9	3	11	4	−1
Subtotal		78		65	13
Shoes		330		165	165
Food cost					
Food at home		4,297		4,332	−35
Food away from home		3,685		3,738	−53
Subtotal		7,982		8,070	−88
Transportation Costs	976 miles	537	486 miles	267	270
Grand Total		13,836		12,881	955

[a]Leisure-time physical activity was valued according to whether participant “disliked”, were “neutral,” or “liked” physical activity.

Note: The “lifestyle” condition is the lifestyle weight-loss condition. Time is reported as a percentage, unless otherwise noted. Extreme outliers in reported “time” and “miles” (those more than 3 SDs from the unadjusted mean) were removed when calculating the adjusted mean hours and miles in the participant time and transportation categories reported here. The cost presented for all categories, except adjusted exercise, is the product of the remaining “trimmed” means, percentages, miles, or hours and the associated unit costs.

Table 6

Per capita differences in cost of lifestyle group condition relative to usual care condition over 2 years, HELP PD[a]

	Lifestyle vs usual care condition ($)
Direct medical costs	
Intervention	708
Care Outside HELP PD	−2277
Total	−1569
Direct nonmedical costs	955
Indirect costs	0
Total costs	
Health system perspective	−1569
Societal perspective	−614

Note: The "lifestyle" condition is the lifestyle weight-loss condition.

[a]2010 U.S. dollars

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