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A Cost Analysis of Community Screening for Diabetes in the Central Wisconsin Medicare Population

(Results from the MetaStar Pilot Project in Wausau)

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ABSTRACT

Context – Type 2 diabetes mellitus is often undiagnosed and untreated.

Objective – To estimate the costs and possible savings of screening for Type 2 diabetes mellitus in the Wisconsin Medicare population from a population health perspective.

Design – The costs and benefits of community screening were analyzed using various primary and secondary data sources. Data on the community screening were obtained by MetaStar, collaborators at the screening site, and published material. Results from a Monte Carlo simulation model, developed by the CDC Diabetes Cost-Effectiveness Study Group, and recent developments in diabetes research were used to estimate the incidence levels of major complications for Type 2 diabetes.

Setting and Participants– Medicare beneficiaries in central Wisconsin residing in the Wausau Hospital Service Area, which is composed of 14 zip codes.

Results – Of 826 Medicare patients screened, 32 were diagnosed as having diabetes. If we use the same assumptions offered by the CDC Study Group, we find that the excess lifetime costs from screening and early treatment ($4850) exceed costs saved from preventing complications ($378), costing an average of $4471 per diabetic. However, if we alter assumptions on cardiovascular disease reduction risk and routine care costs, we find that screening could save an average of $619 per diabetic detected.

Conclusions – The costs of community screening, using the CDC Study Group's assumptions, are greater than the costs of diabetes without screening in this population. However, recent evidence on cardiovascular disease risk and routine care costs could alter the results, leading to lower costs and greater benefits in the future. More research is necessary, particularly in the area of quality of life measures, to more accurately reflect the benefits of screening.

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INTRODUCTION

Although diabetes affects about 3% of the US population, the costs of diabetes make up about 12% of total US health care expenditures,[1] or about $100 billion per year.[2] On average, a person with diabetes spends about $11,000 per year on medical care, whereas a person without diabetes spends about $2,600.[3] Although early diagnosis and treatment to control glycemia can prevent complications,[4] some studies have shown that a person may have Type 2 diabetes for 9 to 12 years before it is diagnosed.[5]

Diabetes meets criteria for public health screening.[6] In particular, diabetes is common, it can be diagnosed in the asymptomatic phase, and early diagnosis and treatment can be beneficial to the patient in terms of slowing the progression of disease and increasing longevity.[7] However, there are also costs associated with diabetes screening, including the initial cost of screening and early treatment costs that would not have been incurred if the disease had not been detected earlier with screening. Other costs may include psychosocial costs such as misdiagnosis, iatrogenic treatment and other costs. Understanding the costs and benefits of screening for major diseases is a necessary tool to help determine health care policy and practice.

A study done by the CDC Diabetes Cost-Effectiveness Study Group provided an estimate of the lifetime costs and benefits of opportunistic screening for Type 2 diabetes in the United States.[4] The major benefits from screening were derived from additional years of life or reduced incidence of major complications including blindness, end stage renal disease, lower extremity amputation, and cardiovascular disease. The major

Table 1. Characteristics of Patients in a Community-Based Screening for Diabetes, Wausau 1998

Mean Age (Years)	72.6
Medicare beneficiaries in setting A	13,664
Medicare beneficiaries already diagnosed as diabetic	1349/13,664 = 9.9%
Undiagnosed Medicare beneficiaries eligible for screening	12,357
Medicare beneficiaries screened	826/12,357=6.7%
Medicare beneficiaries screened positive	87
Of those screened positive, those who followed up with visit to physician	75
Diagnosed as diabetic	32/826=3.9%

Note: Table reproduced from an unpublished MetaStar report.

Table 2. Lifetime Cumulative Incidence (percentage) of Diabetic Complications (65 years of age and older)

	End stage renal disease	Blindness	Lower extremity amputation	Cardiovascular disease (assumptions)*	
				1	2
Without screening	0.3	1.7	1.0	39.8	39.8
With screening	0.2	1.1	0.7	39.8	27.8
Screening effect	-0.1	-0.6	-0.3	0	-12.0

*Assumption #1 – No risk reduction (CDC)
Assumption #2 – 30% relative risk reduction (12% difference)

costs from screening were the initial cost of screening and the costs of early treatment that would not have been incurred if the disease had not been detected earlier with screening. In the CDC model, for people aged 65 or older, lifetime costs associated with routine management and treatment of major complications for diabetics in the screening group were $32,490 per diabetic. Comparable costs for diabetics of the unscreened group were $27,903 per diabetic. In other words, implementation of a national screening program for people aged 65 or older would cost an additional lifetime cost of $4587 per diabetic.

In this paper, we conducted two analyses. First, we utilized the CDC model to compare the costs of community screening and early treatment with the savings accrued from reduced incidence of major complications. Second, we altered the CDC model by assuming a 30% reduction in the risk of cardiovascular disease to reflect recent new evidence from the UK studies in 1998.[8,9] We also assessed the effect of screening on routine diabetes care. The impacts of both of these changes are presented.

RESEARCH DESIGN AND METHODS

We used the cost-effectiveness method developed by the CDC Diabetes Cost-Effectiveness Study Group.[4] The Study Group developed a Monte Carlo computer simulation model and utilized data from past clinical trials, epidemiological studies, and other sources. In their model, a single-payer system was assumed, health care providers used fasting plasma glucose tests for diabetes screening, and opportunistic screening reduced the prediagnosis interval by 5 years.

The CDC model created a hypothetical population of newly diagnosed diabetics and separated it into two groups: 1) with screening, 2) without screening. Their model then simulated the disease progression of four major complications: blindness, end-stage renal disease, lower-extremity amputation, and cardiovascular disease. The disease progressions of major complications were modeled on glycemic levels.

Community Screening

The MetaStar population included Medicare beneficiaries living in central Wisconsin. The geographic area is defined as the Wausau Hospital Service Area (HSA) and composed of 14 zip codes. The study design, implementation, and screening techniques have been reported previously.[10] Briefly, the screening was conducted on three separate days in different areas of the HSA in May of 1998. All Medicare beneficiaries age 65 and older with undiagnosed diabetes were targeted. This information was obtained from the Medicare Part A and part B claims. T hose who were previously diagnosed with diabetes were excluded from the study. Individuals who were tested positive at the screening site were then referred to a physician. See Table 1.

Brochures were sent to all targeted Medicare beneficiaries. The brochures listed risk factors for diabetes including obesity and lack of exercise. If the person had one of these risk factors (along with being over age 65), the mailing recommended that the person attend one of the screening days. The brochure stated that prizes would be given at the sites. Radio, TV, newspaper announcements, store posters, and church bulletins were used to publicize these screening days. A random blood glucose of >= 120 mg/dl was used as a positive screen.

Those who were screened positive were referred to their primary care physician or to a specific provider from a list of providers if the beneficiary did not have a primary physician. Phone call follow-ups were done if the person did not make the first appointment. Individuals involved in this project included physicians, nurses, nutritionists, hospital and clinic administrators, public health directors, and community resource staff.

Screening costs were divided between MetaStar and the community. MetaStar provided the brochure printing and mailing. The community provided the staffing and supplies at the screening site, food and gift donations. The total cost of screening was estimated to be $3200.

Incidence of Complications

The CDC study calculates the lifetime cumulative incidence of end stage renal disease, blindness, lower-extremity amputation, and cardiovascular disease for the screened group and unscreened group as shown in Table 2. However, it does not provide the timeline for when these complications occur. We assumed that the incidence of disease increases linearly by year from zero risk, such that the total lifetime incidence equals that given by the CDC.

In addition, the CDC assumed that glycemic levels do not affect cardiovascular disease. Their study states, "Because the link between glycemic level and cardiovascular disease is uncertain, our base case model restricts the causal links to the microvascular complications, which may understate some of the benefits of early detection and treatment".[4] Since this study was published, the UK diabetes group found that glycemic control with tight blood pressure control reduces the risk of myocardial infarction by 39% for Type 2 diabetes.[8] With this new knowledge, we included in the model a reduction of risk for cardiovascular disease of 30%.

Cost Model

The costs are derived from the same sources as provided by the CDC Study Group (Table 3). The major costs are due to outpatient visits, case management, and medication. The cost of routine care for diabetics ranges from $1007 to $1277 per year. These costs are in addition to routine costs for nondiabetics (average $1939 per year). It is important to note that in the CDC model, the routine costs of treating diabetes are assumed to be unaffected by screening; however, there may be lower cost of routine treatment during the 5-year lead time period.[5] It is hypothesized that because screening allows diabetics to be detected early, many of these individuals are given less expensive regimens than the unscreened group. These less expensive regimens include fewer medications prescribed or simply diet and exercise. In this analysis, we assumed that these regimens for the screened group reduced treatment costs by one-third for the first 5 years after onset of disease. We also assumed a discount rate of 3%.

Costs are also incurred from complications. The complications reported in this paper are blindness, end-stage renal disease, lower-extremity amputation, and cardiovascular disease. The costs of these complications are also listed in Table 3.

All of these variables are year-based costs from onset of diabetes to age of death. After finding the cost for each year from onset of diabetes to death, we totaled the costs. The mean age of diagnosis with screening is 72.6, and the estimated life expectancy for men and women aged 72.6 is 9.5 years.[11] Thus, we estimated that the diabetics diagnosed during the screening will on average live to 82.1 years of age. Assuming that screening allows for earlier diagnosis by on average 5 years, and that regular diagnosis occurs on average 10 years after onset of diabetes, we calculated on average a total of 14 years from onset of diabetes to death. We assumed, as did the CDC, that life expectancy does not change with the screened group and unscreened group for individuals age 65 and older.

Table 3. Costs for Treatment, Complications, and Screening for the Cost-effectiveness Model (in dollars)

Routine Diabetic Care[1]	$1007/year
Complications[1]	
Blindness	$1997/year
End-stage renal disease	$68,131/year
Cardiovascular disease	$2757/year
Lower-extremity amputation[2]	$31,749/episode
Screening costs[3]	$100/diabetic

[1]Source: CDC
[2]The lower-extremity amputation is the average cost.
[3]Source: MetaStar. Total cost = $3200 for 32 diabetics = $100/diabetic diagnosed.

RESULTS

Of the 13,664 Medicare beneficiaries in the study area, 1349 (9.9%) were diabetic and excluded from the study. Of the remaining 12,357 beneficiaries, 826 (6.8%) were screened. Of the 826 beneficiaries screened, 32 (3.8%) were diagnosed as being diabetic.[10]

Table 4 shows the results of the cost analysis. The costs of screening the entire population were estimated to be $3200 or an average of $100 per diabetic diagnosed. The lifetime costs of diabetic routine care were $4750 greater for those detected during screening, compared to the costs if they had not been detected earlier with screening ($11,716 versus $6966). On the other hand, the costs for treatment of microvascular complications were reduced by $278 as a result of screening and the extra routine care. These costs were further reduced by $1224 assuming a 30% reduction in cardiovascular disease risk. Therefore, the excess lifetime costs associated with screening ranged from $3246 to $4471 depending on the impact on cardiovascular disease risk reduction. If the costs of routine care from early treatment for the screened group were reduced by one-third ($11,716 to $7850 per diabetic) for the first 5 years of care and we assume a 30 percent reduction in cardiovascular disease risk, screening actually saves an average of $619 per diabetic detected.

Table 4. Results of cost analysis (dollars). Average lifetime costs for screening, routine care, and diabetic complications, among persons screened and unscreened for diabetes[1]

	Unscreened	Screened[2]	Screened[3]	Screened[4]
Cardio-vascular disease	$4095	$4095	$2871	$2871
End stage renal disease	762	508	508	508
Blindness	126	74	74	74
Lower extremity amputation	240	168	168	168
Routine care	6,966	11,716	11,716	7,850
Subtotal	12,190	16,561	15,337	15,337
Screening		100	100	100
Total cost/ diabetic	12,190	16,661	15,437	15,437
Cost/ difference		+4471	+3246	-619

[1]The authors assumed a discount rate of 3%.
[2]Assumption: no cardiovascular disease risk reduction.
[3]Assumption: 30% cardiovascular disease risk reduction.
[4]Assumption: 30% cardiovascular disease risk reduction and 30% reduction in routine medical care costs.

DISCUSSION

In this study, using a cost-benefit model from the CDC, we found that the costs related to a community screening program were generally greater than the savings accrued from the reduction in the lifetime incidence of major complications. However, assuming a 30% reduction in cardiovascular disease risk and a one-third reduction in the costs of routine care for the first 5 years of care, screening led to a cost savings of $619 per diabetic detected.

The results of this study do not argue for or against screening for diabetes in the Medicare population. Rather, this study attempts to compare the economic costs associated with a Wisconsin community diabetes screening program with the savings accrued from the reduction of risk of major diabetes-related complications from a health care payer perspective. Indeed, screening policies must be developed that consider not only the economic costs and benefits, but also quality of life issues and other indirect costs and savings. While this study does not address quality of life issues, it may be that the benefits of early diagnosis of diabetes do not lie solely in dollar savings, but also in the quality of life of the diabetics detected early through screening. More research is needed to determine the true benefits of diabetes screening in the Medicare population.

Several limitations should be considered when interpreting the results. Admittedly, the CDC cost-effectiveness model was based on the US population, and we applied it to a Wisconsin population, which may not be representative of the nation. We tried to adjust accordingly by modifying the age of diagnosis of diabetes and the life expectancy of diabetics to better reflect Wisconsin. However, other differences may exist and could not be modeled, which may affect results.

Second, the cost data were obtained by the CDC and were assumed to be similar to the costs in Wisconsin. Major differences may affect the results. For example, if the cost of routine treatment nationally was significantly higher than the cost in Wisconsin, the costs associated with the screening group would be overestimated. However, if the cost related to end stage renal disease nationally was higher than the cost in Wisconsin, the costs associated with the screening group would be underestimated.

Third, differences in the incidence rates of complications may impact the model. We assumed that the incidence of complications increases linearly as time passes. The CDC study provided lifetime cumulative incidence of all major complications for both groups: screened and unscreened; however, it did not specify the time diabetics are most likely to realize these complications. We assumed that a person who had diabetes for 1year had one-tenth the incidence for blindness as another person with diabetes for 10 years. Different assumptions in the risk of disease, such as an exponential increase in the risk of disease, would have influenced the results of the analysis.

Finally, our model does not take into account the potential differences in the prevalence rate of diabetes. The prevalence rate of diabetes would not change the results of this study, which is in costs per diabetic. However, a difference in the prevalence rate would affect the total costs associated with the screened and unscreened group.

The goal of diabetes screening is to detect undiagnosed diabetics, begin treatment, and reduce the risk of diabetes-related complications. The cost to a health care organization or health plan would include not only the costs of screening, but also the costs associated with early diagnosis and treatment. With the CDC model and some modifications to better reflect the Wisconsin Medicare population and new research, we found that the costs of community screening due to early diagnosis and treatment will be partially offset by the benefits of reduced complications. By adding the assumptions of reduced complications from cardiovascular disease and of reduced cost of routine care, we show that a community diabetes screening program can be cost saving in the long run.

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