Impact of Secondary Prevention in an Occupational High-Risk Group

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**Background:** A study of medical outcomes among 6857 elderly construction workers who received an initial and at least one periodic follow-up examination as a result of participating in a medical screening program was undertaken. **Methods:** We compared results from the initial examination to follow-up examinations delivered at least 3 years after the initial examination for the following outcomes: body mass index (BMI); total serum cholesterol; non-high-density lipoprotein (non-HDL) cholesterol; hemoglobin A1c; hypertension; current cigarette smoking; and 10-year cardiovascular disease (CVD) risk scores. **Results:** Statistically significant improvements ($p < 0.05$) were observed for all measures except BMI. **Conclusions:** Participation in a periodic medical screening program for elderly construction workers is associated with a favorable impact on common health outcomes. When presented with a program designed for them, blue-collar workers are motivated to seek improvements in their health status.

**Background**

Do periodic medical examinations in an elderly population of blue-collar workers have a beneficial effect on health outcomes? Will these workers take advantage of the services offered, and will they follow recommended health-promoting advice? In this study, we try to answer these questions, using results from a medical screening program that is offered to construction workers who have been employed in the nation’s nuclear weapons facilities.

The primary goal of Building Trades National Medical Screening Program (BTMed) is the identification of health conditions possibly related to occupational exposures experienced while working on US Department of Energy (DOE) sites. Prior reports have described the history of BTMed and its work history and medical components, the prevalence of lung disease, chronic obstructive pulmonary disease, hearing loss, beryllium sensitivity, and mortality.

**Methods**

BTMed began screening workers in 1997, and in September 2005, it began to offer follow-up examinations every 3 years. However, the available budget does not allow for follow-up for all the participants who are eligible for it, and is provided on a first-come-first-serve basis to eligible participants who contact the program and request it.

**Medical Screening Protocol**

Participation in the BTMed is voluntary and without cost to workers. Workers potentially eligible for participation are identified through multiple sources, including union rosters, contractor records where available, media advertisement, and presentations at worker meetings. BTMed operates a website (http://www.btmed.org) to provide workers with information about the program, instructions for participation, and health information. Ten outreach offices are located in regions with major DOE sites.

The screening program uses a two-step design with the initial step consisting of a detailed work history interview to provide information concerning work-related exposures and a medical screening examination performed under contract with local clinical providers who meet credentialing requirements and adhere to a detailed protocol. All data from the intake, work history, medical history, physical examination, medical examination, and laboratory results are reviewed by BTMed nurses and entered into a database for purposes of program administration, reporting, and statistical analyses.

The screening examination includes a medical history and symptom questionnaire; a smoking history; a physical examination; a posterior-anterior (P-A) chest radiograph classified by a B-reader according to International Labour Office (ILO) Classification of Radiographs of Pneumoconiosis; audiometry; a panel of blood
tests to measure general clinical parameters as well as specific tests chosen to assess end organ damage from identified toxins; BelPT (a blood test for beryllium sensitization); a fecal occult blood test (FOBT); and spirometry meeting ATS standards.\textsuperscript{13,14} The protocol has undergone several updates since startup. Total serum non-high-density lipoprotein (non-HDL) cholesterol was added in 2007 and hemoglobin A1c (HbA1c) was added in 2009. Recording of worker self-reported prescription medication use in the electronic records was initiated during 2002.

BTMed program participants are notified promptly of any findings requiring immediate medical attention and receive a letter providing detailed results of their examinations as well as recommendations for follow-up with their health care provider, where appropriate. Program quality and participant satisfaction are continuously monitored through a brief questionnaire sent to all participants completing a medical screening.

**Study Population Definition and Outcomes**

All workers undergoing an initial examination and at least one follow-up examination through March 2015 were selected. At that time, 19,870 participants had completed an initial examination.

The focus of this investigation was changes in body mass index (BMI), total serum cholesterol, non-HDL cholesterol, HbA1c, hypertension, and current cigarette smoking among workers undergoing initial and follow-up examinations. Data for the initial examination and the first follow-up examination were used for this study except for HbA1c tests. HbA1c was added to the examination protocol in 2009 as a result of changes in clinical guidelines for screening and detection of diabetes\textsuperscript{15}; therefore, fewer measurements were available for this clinical parameter. In order to increase the number of HbA1c test results available for analyses, each worker’s first examination with an HbA1c measurement was used as the initial measure and data from the next follow-up examination were used for follow-up examination results.

Hypertension was defined as a systolic blood pressure in excess of 140 mm Hg or a diastolic blood pressure in excess of 90 mm Hg. Total serum cholesterol of at least 200 mg/dL, and non-HDL cholesterol at least 160 mg/dL were defined as elevated for prevalence calculations. HbA1c was considered elevated if at least 8.0 and obesity was defined as a BMI at least 30 kg/m\textsuperscript{2}.

- Age, sex, uncontrolled hypertension, smoking, dyslipidemia, and diabetes are the major risk factors for developing cardiovascular disease (CVD). In addition to analyses of changes in individual modifiable CVD risk factors between initial and follow-up examinations, we investigated changes in risk for all CVD using scores from a multivariate risk factor algorithm developed from the Framingham Heart Study. These analyses were based on a subset of workers without any missing data needed to calculate the predicted 10-year risk of CVD based on the prediction equations developed by D’Agostino et al.\textsuperscript{16} The definition of diabetes in these prediction equations is based on fasting glucose or use of insulin or oral hypoglycemic medications. As we could not be assured that BTMed glucose values were based on fasting blood samples, we defined diabetes as a self-reported history of diabetes. We made two calculations for each worker. The first calculation was based on age and clinical parameters at the time of their follow-up examination, so this represented their actual predicted 10-year CVD risk at follow-up. We also calculated a 10-year predicted CVD risk at follow-up assuming no changes in the initial clinical measures between initial and follow-up but allowing for aging. This latter calculation is a hypothetical or counterfactual CVD 10-year risk assuming workers had the same risk factor profile except age at their follow-up examination. We compared these CVD risk profiles in order to determine differences attributable to changes in clinical parameters between examinations.

**Statistical Analyses**

Changes in BMI, total serum cholesterol, non-HDL cholesterol, HbA1c, and 10-year CVD risk between initial and follow-up examinations were assessed using a t test for paired data (SAS Proc TTEST, SAS Institute Inc., Cary, NC). Changes in prevalence of elevated total and non-HDL cholesterol, elevated HbA1c, and prevalence of current smoking between examinations were evaluated using a McNemar test for paired proportions (SAS Proc FREQ, SAS Institute Inc., Cary, NC). Potential impacts of increased use of prescription medications associated with changes in values for total and non-HDL cholesterol and HbA1c were evaluated using unbalanced analysis of variance (ANOVA) methods (SAS Proc GLM, SAS Institute Inc., Cary, NC). Change in prevalence of hypertension at follow-up associated with new medication use was evaluated on the basis of Wald adjusted confidence limits for differences in proportions.\textsuperscript{17}

All statistical analyses were conducted using SAS Version 9.3.\textsuperscript{18}

**Human Subjects Protection**

BTMed is conducted with annual review and approval by two Institutional Review Boards: The US DOE Central IRB is the IRB of record and the IRB of CPWR—The Center for Construction Research and Training provides secondary review. Informed consents are administered at three points of screening process: when participants enroll, at the time of the work history interview, and before each medical examination. All data received by CPWR investigators are de-identified under procedures approved by the DOE IRB.

**RESULTS**

Of the 19,782 participants who had completed an initial examination at the time of the cut-off for this study (March 30, 2015), 6587 (33.3%) had completed at least one follow-up examination. These participants constitute the study population. Table 1 compares the demographic and select medical characteristics of the study population and the overall population. The two tables below compare the characteristics of the study participants and all participants completing an initial examination.
Participants in the study population were largely male (94.7%) and Caucasian (86.1%). The mean age at initial examinations was 58. The mean age at follow-up was 64 years (not shown in table).

Comparisons of study outcomes measures at initial and follow-up examination are summarized in Table 2. Mean BMI increased from 29.7 to 30.0 between examinations and this increase was statistically significant \( (P < 0.05) \). The prevalence of obesity significantly increased from 41.0% to 43.7%.

Both mean total and non-HDL cholesterol decreased significantly between examinations (Table 2). Mean total cholesterol decreased from 197.2 to 183.1 mg/dL \( (P < 0.05) \) and non-HDL cholesterol decreased from 138.7 to 135.1 mg/dL \( (P < 0.05) \). Distributions of these measures by examination are shown in Figs. 2 and 3. The prevalence of total cholesterol at least 200 mg/dL and non-HDL cholesterol at least 160 mg/dL was significantly reduced at the follow-up examination \( (P < 0.05) \).

Hemoglobin A1c \( (< 8.0 \text{ on initial examination (} N = 55), \text{Mean (SE)} = 9.3 (0.14) \text{, } P < 0.05) \) and \( (< 8.0 \text{ and no diabetes history (} N = 9), \text{Mean (SE)} = 9.3 (0.25) \text{, } P < 0.05) \) decreased from 9.3 to 8.5.

Prevalence of uncontrolled hypertension decreased from 26.5% at initial examination to 24.1% \( (P < 0.05) \). Prevalence of current cigarette smokers decreased from 18.4% to 15.3% \( (P < 0.05) \).

Lifestyle and medication interventions are effective for control of serum cholesterol, HbA1c, and hypertension. We analyzed changes in self-reported medication use between initial and follow-up exams for examinations completed on or after January 2002.

As summarized in Table 2, 55 workers were found to have an HbA1c value at least 8.0 on initial examination with a mean value of 9.3. At the follow-up examination, the mean HbA1c was significantly reduced among these workers \( (\text{mean } = 8.5, \text{ } P < 0.05) \).

Prevalence of uncontrolled hypertension decreased from 26.5% at initial examination to 24.1% \( (P < 0.05) \) and prevalence of current smokers decreased from 18.4% to 15.3% \( (P < 0.05) \).

Lifestyle and medication interventions are effective for control of serum cholesterol, HbA1c, and hypertension. We analyzed changes in self-reported medication use between initial and follow-up exams for examinations completed on or after January 2002.
The counterfactual mean 10-year CVD risk based on changes in clinical measures between examinations and these results are summarized in Table 4. Increased use of medications was associated with significant reductions in total serum cholesterol, non-HDL cholesterol for all workers (P<0.05), with significantly greater reductions for workers with total cholesterol at least 200 mg/dL or non-HDL at least 160 at initial examination. There were 2840 workers with a total cholesterol at least 200 mg/dL at initial examination and of those 492 initiated new cholesterol medications before their follow-up examination. Of the 492 workers with new cholesterol medications, 380 (77.2%) were within control guidelines (total cholesterol < 200 mg/dL) at the follow-up examination. For non-HDL cholesterol, 294 workers had a value at least 160 mg/dL at initial examination and 63 initiated new medications before the follow-up examination. Of the 63 workers initiating new medications, 54 (85.7%) had a non-HDL cholesterol less than 160 mg/dL at the follow-up examination.

Overall, mean HbA1c values were not significantly different by examination (Table 4). However, workers with an HbA1c at least 8.0 at initial examination and who initiated new medications experienced a significantly larger reduction at follow-up than workers not starting new medications (P<0.05). Of 55 workers with HbA1c at least 8.0 on initial examination, 20 initiated new medications and 8 (40.0%) had an HbA1c less than 8.0 on follow-up examination.

Use of hypertension medications was very prevalent at initial examination with 31.1% of workers reporting use, increasing to 45.6% at follow-up. Among workers with medication data, 1247 were identified as having uncontrolled hypertension at initial examination and 498 were found to have started hypertension medications or added new medications by the time of their follow-up examination. Of the 498 starting new hypertension medications, 299 (60.0%) were within blood pressure guidelines at follow-up. In addition, 471 of the 1247 workers with hypertension at initial examination reported using hypertension medications and 270 (57.3%) of these workers were found to be normotensive at follow-up.

We also looked at whether participants had a personal physician for follow-up care, if necessary. At the initial examination, 82.1% reported having a physician and 90.3 reported having a physician for follow-up care, a 10% increase.

At total of 1039 workers had sufficient data to calculate 10-year CVD risk scores using the Framingham multivariate risk factor algorithm. Among these older workers, the actual mean 10-year CVD risk at their follow-up examination was 24.9% (SE = 0.50). The counterfactual mean 10-year CVD risk based on clinical parameters at initial examination and allowing for aging was 26.7% (SE = 0.53). The difference in mean 10-year CVD risk [-1.8 percentage points (SE = 0.34), or a decline of 6.7%] was statistically significant (P<0.05), representing an improvement in overall CVD risk among participants.

**DISCUSSION**

BTMed’s objectives address a number of major challenges in public health:

- The Value of Medical Screening to Occupational Safety and Health: The value of preventive health examinations to occupational safety and health is the discovery of health outcomes that can be associated with exposures in the workplace. This knowledge can then be used to promote better safety and health procedures, and can be used to support claims for compensation.
- The Value of Preventive Health Care to Occupational Safety and Health: We have previously reported on our occupational disease findings in a number of areas, including the first demonstration of beryllium disease in construction workers and a significantly different way of looking at chronic obstructive pulmonary disease risks. These findings have been used to promote changes in safety and health procedures within DOE and elsewhere, and also in supporting the need for special provisions for construction workers in OSHA rulemaking on both silica and beryllium.

**FIGURE 3.** Serum non-HDL cholesterol distribution by examination.

**FIGURE 4.** Initial and follow-up hemoglobin Alc, individuals ≥8.0 on initial examination.

**TABLE 3.** Prevalence of Medication Use at Initial and Follow-Up Examination

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Initial Examination</th>
<th>Follow-Up Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholesterol medications, N (%)</td>
<td>1,161 (22.5)</td>
<td>1,766 (34.2)&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Hypertension medications, N (%)</td>
<td>1,607 (31.1)</td>
<td>2,357 (45.6)&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Diabetes medications, N (%)</td>
<td>419 (8.1)</td>
<td>694 (13.4)&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>1</sup>Medications were first entered into the electronic record during 2001. Data are for 5,172 examinations completed on or after January 1, 2002.

<sup>2</sup>Prevalence of medication use at follow-up examination significantly different from initial examination (P<0.05).

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TABLE 4. Changes in Follow-Up Clinical Measures and Medication Use

<table>
<thead>
<tr>
<th>Measure (Number With Data)</th>
<th>No New Medications</th>
<th>New Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total serum cholesterol (N = 4,902)</td>
<td>[4,016] - 4.3 (0.54)</td>
<td>[886] - 43.7 (1.41)</td>
</tr>
<tr>
<td>All workers [N], Mean change (SE)</td>
<td>[2,443] + 4.5 (0.59)</td>
<td>[394] - 20.0 (1.66)</td>
</tr>
<tr>
<td>&lt;200 mg/dL on initial examination, [N], Mean change (SE)</td>
<td>[1,573] - 18.0 (0.93)</td>
<td>[492] - 62.7 (1.74)</td>
</tr>
<tr>
<td>≥200 mg/dL on initial examination, [N], Mean change (SE)</td>
<td>[685] + 6.2 (1.02)</td>
<td>[75] - 17.4 (3.70)</td>
</tr>
<tr>
<td>Non-HDL serum cholesterol (N = 1,054)</td>
<td>[916] 1.8 (0.98)</td>
<td>[138] - 38.8 (3.33)</td>
</tr>
<tr>
<td>All workers [N], Mean change (SE)</td>
<td>[63] - 11.4 (2.24)</td>
<td>[63] - 64.3 (3.86)</td>
</tr>
<tr>
<td>&lt;160 mg/dL on initial examination, [N], Mean change (SE)</td>
<td>[231] - 11.4 (2.24)</td>
<td>[63] - 64.3 (3.86)</td>
</tr>
<tr>
<td>≥160 mg/dL on initial examination, [N], Mean change (SE)</td>
<td>[85] - 6.2 (1.02)</td>
<td>[75] - 17.4 (3.70)</td>
</tr>
<tr>
<td>Hemoglobin A1c (N = 1,295)</td>
<td>[1,211] + 0.05 (0.02)</td>
<td>[84] - 0.01 (0.16)</td>
</tr>
<tr>
<td>All workers [N], Mean change (SE)</td>
<td>[1,176] + 0.06 (0.01)</td>
<td>[64] + 0.33 (0.13)</td>
</tr>
<tr>
<td>HbA1c &lt;8.0 on initial examination, [N], Mean change (SE)</td>
<td>[35] - 0.60 (0.28)</td>
<td>[20] + 1.11 (0.45)</td>
</tr>
<tr>
<td>HbA1c ≥8.0 on initial examination, [N], Mean change (SE)</td>
<td>[916] 1.8 (0.98)</td>
<td>[138] - 38.8 (3.33)</td>
</tr>
<tr>
<td>Uncontrolled hypertension (N = 5,158)</td>
<td>[3,911] not hyperinitial, hypertensive follow-up, [N] (%)</td>
<td>[491] (16.2)</td>
</tr>
<tr>
<td>All workers [N], Mean change (SE)</td>
<td>[326] (45.5)</td>
<td>[154] (17.3)</td>
</tr>
<tr>
<td>Uncontrolled hypertension (N = 5,158)</td>
<td>[1,247] hyperinitial, hypertensive follow-up, [N] (%)</td>
<td>[326] (45.5)</td>
</tr>
<tr>
<td>3,911 not hyperinitial, hypertensive follow-up, [N] (%)</td>
<td>[154] (17.3)</td>
<td></td>
</tr>
<tr>
<td>1,247 hyperinitial, hypertensive follow-up, [N] (%)</td>
<td>[199] (40.0)</td>
<td></td>
</tr>
</tbody>
</table>

HbA1c: hemoglobin A1c; HDL: high-density lipoprotein.

1The number of individuals with data for both initial and follow-up examination for each measure. Medications were first entered into the electronic record after January 1, 2002.

2HDL and hemoglobin A1c were added to the examination protocol 9 years after the initial examination.

3Hypertension defined as systolic ≥140 mm Hg or diastolic ≥90 mm Hg.

4Among 1,247 workers with hypertension at initial examination, 471 (37.8%) reported using hypertension medications at the initial examination. Also, 1,135 (29.0%) without uncontrolled hypertension on initial examination reported using hypertension medications at initial examination.

5Statistically significant difference comparing those with and without new medications at follow-up using unbalanced ANOVA for continuous variables and chi square association for hypertension prevalence.

Exposures. In addition, these findings also helped support the passage of the Energy Employees Occupational Illness Compensation Act in 2000.

• Occupational High-Risk Management: The recognition that workers who were found to have been placed at a high risk for occupational diseases should be entitled to notification of this risk and to follow-up care appropriate to the risk has developed over the past 35 years.19 BTMed is administered in this tradition, and adds significantly to experience of this field. It is in part from this experience that we decided that the general health parameters examined in this study should be included in our health examinations.20

• The Value of Periodic Preventive Health Examinations: Although the evidence to support the practice of delivering annual health examinations is equivocal and hotly discussed,21–24 the procedures reported on in this study are supported by the United States Preventive Services Task Force. Although BTMed is administered to an aging population with a high risk, which, sets it apart from health services delivery to the general population, our findings suggest that we can impact health favorably using a targeted periodic examination with careful follow-up.

• Aging Workers: The American population has aged greatly over the last 30 years, a trend that is projected to continue for the next 20 to 30 years,25 leading to many challenges in terms of sustaining retirement and caring for people with multiple chronic disease conditions, and at the same time many people are also healthy and active longer into late life than before. In BTMed, we confront both of these challenges. The mortality patterns in the BTMed population appear to be contradictory.26 On the one hand, our population has an overall mortality risk that is lower than the general population. On the other hand, the BTMed population has a significantly higher than average risk for cancer and nonmalignant pulmonary diseases, which can be ascribed to occupational exposures these workers have experienced during the working life. That discrepancy is in part because the workers who enroll in BTMed have spent a lifetime in construction, which requires high functional capacity. Less than 20% were smokers when they came for their initial examination, compared with a smoking rate of 29.7% among adult construction workers.26 So, those workers who last a life-time typically are survivors. This is frequently described as the “healthy worker effect.”27

• Health-seeking behavior in lower SES populations: Low SES people are less likely to be health seekers than people in higher SES strata because they face a variety of barriers, including beliefs, economics, time, and logistics.28–30 Our study of this blue-collar population challenges that paradigm. When presented with a program designed for them, our findings suggest that our participants are likely to seek improvements in their health status.

In our population, demand for screening services consistently exceeds our ability to serve due to budget constraints, and participation among those eligible for follow-up examinations (alive, 3 years since last examination, and for whom we had good contact information) has been so great that we have had to space out examination schedules long into the future. Nevertheless, over 99% of participants who submit satisfaction surveys report they are satisfied with the services we deliver.

CDC reports that 51.4% of noninstitutionalized US adults aged 55 to 64 years had high blood pressure in the period 2009 to 2012, 18.9% had diabetes, 50.1% had high cholesterol, and 40.6% were obese.31 We observed a lower rate of diabetes and hypercholesterolemia in our screened population, but a similar rate of obesity. In 2012 to 2013, 18.1% of noninstitutionalized adults aged 55 to 64 years were current cigarette smokers, again very similar to our screened population. This high rate of participation and our findings suggests that our participations are interested in improving their health.

In the longitudinal Health and Retirement Study, construction workers have reported significantly worse functional capacity than other occupations consistently over time.32 Although over 80% of construction workers who belong to a union report receive health insurance as part of their work, such insurance lapses during periods of no work, and most nonunion construction workers do not have employment-based health insurance.33 Data from National Health
Interview Survey and Medical Expenditures Panel Survey show that 31% of construction workers had their last contact with a doctor or other health professional more than 1 year before the survey, with the proportion increasing to 54% in uninsured workers.27 Although we did not collect information on medical utilization among our BTMed participants, we did find that almost 20% did not report a periodic health visit on initial examination, and it is likely that many of them had not had a recent periodic health visit.

Although there is little evidence to support periodic health examinations, there are significant differences between a general annual medical examination and targeted screening recommendations, such as those recommended by the US Preventive Services Task Force. There is growing evidence that programs which focus on specific disease outcomes or biomarkers tend to show benefits of a periodic assessment.34,35 A recent evaluation from the UK of the National Health Service’s Health Check program, which focuses on CVD and diabetes, found statistically significant reductions in overall CVD risk, systolic and diastolic blood pressure, and total cholesterol. A recent worksite study found significant benefits. These findings are similar to what we found; however, only 21.4% of the eligible population had participated in Health Check.36 Significant benefits of worksite screening programs with regard to identification of undiagnosed hypertension and subsequent therapeutic treatment have been demonstrated.37

Approximately one-quarter of people with diabetes in the U.S. are undiagnosed; of those with a diagnosis of diabetes 33% to 49% do not meet targets for glycemic, blood pressure, or cholesterol control, and only 13% meet targets for all three measures and nonsmoking status.38,39 There is clear evidence that meeting targets for diabetes leads to decreased morbidity and mortality, and clearly individuals who do not know they have diabetes have no opportunity to improve management of the disease. The American Diabetes Association not only recommends periodic screening with HbA1c but also states that “community testing outside a health care setting is not recommended because people with positive tests may not seek, or have access to, appropriate follow-up testing and care.”40

Uncontrolled hypertension is a major contributing factor to cardiovascular and all-cause mortality in the United States,40 and the evidence on the benefits of screening for high blood pressure is well-established, and screening is recommended either annually or bi-annually by the United States Preventive Services Task Force, the Seventh Joint National Committee, the American Heart Association, and the American Academy of Family Physicians. The most recent guidelines for treatment of high cholesterol are based on a risk analysis that includes determination of total cholesterol and HDL-cholesterol, and the level should be checked after institution of treatment or changes in lifestyle that may affect the need for treatment. All of these guidelines necessitate regular visits to a primary care provider for medical conditions that are asymptomatic.

We report a 17% smoking cessation rate among the workers who were smokers at initial examination, with a decrease from 18.4% prevalence of current smokers to 15.3% at follow-up. A recent Cochrane review reported that physician advice to quit smoking generally has a small effect; a brief advice intervention can increase quitting by a further 1% to 3% beyond an unassisted quit rate of 2% to 3%, for a total quit rate of 3% to 6%.41 Another Cochrane Review, also recent, of workplace smoking cessation programs found that most interventions focused on the individual, whether group counseling, individual counseling, or pharmacologic therapy doubled the smoking cessation rate over a control group, and that self-help was generally not efficacious.42 We advised our participants to quit smoking, provided educational information and referral to a local smoking cessation program, or a toll-free telephone quit line for assistance. It appears that our relatively minor intervention, in the context of the overall program, was able to achieve smoking cessation rates usually seen with more intensive interventions.

There are some limitations in our data. Periodic health examinations represent a series of “one-shot” data points. Although our clinical providers are expected to repeat an elevated blood pressure to confirm the result at the time of the visit, guidelines recommend that a diagnosis of hypertension not be made on a single clinic visit. Therefore, some of our participants would be expected to have improved blood pressure on re-examination without any medical intervention.42 However, for the individuals who, on re-examination, were taking new or additional blood pressure medication, we presume that the elevated blood pressure was confirmed by their primary care provider.

The ADA recommends an elevated HbA1c be confirmed with a second test, which can include a fasting blood sugar or repeat HbA1c, before a definite diagnosis of diabetes can be made. The certainty of the initial test representing diabetes increases with the level of the HvA1c; a level over 8 is highly likely to be confirmed with some second test. Our participants with an HbA1c more than 8 were significantly likely to improve on re-examination.

Our study population of workers undergoing follow-up examinations is not a random sample of those initially screened and it would be impossible to obtain such a sample without denying screening examinations to workers who request them, an obvious ethical problem. A selection bias might exist if workers who had a subsequent visit with their primary care physician or who quit smoking were more likely to return. Although we do not have data to address this issue directly, we did compare workers in the study sample with all workers undergoing an initial examination (Table 1) and did not observe meaningful differences in demographics characteristics or prevalence of the conditions studied. Thus, while we cannot entirely rule out selection bias, such a bias seems unlikely to explain the results observed.

CONCLUSIONS

In this analysis, we demonstrate that on multiple measures the individuals who participated in the Building Trades Medical Screening Program benefited from significant improvements in measures for diabetes, blood pressure, cholesterol, smoking cessation, and overall cardiovascular risk 3 or more years later. This analysis suggests a significant benefit for a screening examination in a group of older construction workers, many of whom may never have had other than episodic medical care. The evidence to support the practice of delivering annual health examinations is equivocal and highly discussed.21–24 Although BTMed is administered to an aging blue-collar population with a high risk, which sets it apart from health services delivery to the general population, our findings suggest that we can impact health favorably using a targeted periodic examination with careful follow-up.

REFERENCES
