

# Cost-effectiveness of a prework screening program for the University of Illinois at Chicago Physical Plant

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**Abstract.** A post-offer screening program jointly developed by the Occupational and Physical Therapy Departments (University of Illinois at Chicago) was first implemented in March 1998. A total of 712 screens were completed from 3-01-98 through 2-28-01. A quasi-experimental design was utilized to analyze changes in Workers' Compensation costs between the three-year period prior to, and the three-year period following program inception. Additionally, injury rates and mean cost per injury were compared between injuries sustained between 3-98 and 3-01 which were incurred by workers who had passed screening and those that had not been screened. Finally, the tabulated cost per screen and reduction in Workers' Compensation costs allowed derivation of a dollar spent/ dollar saved ratio.

Dramatic declines in number of injuries, total costs and mean cost per case occurred in the three-year period following program inception. Mean cost per case also dramatically declined comparing injured workers who had passed screening versus those who had never been screened. Cost savings were over \$18 per dollar spent on the program.

While a number of mitigating variables may have accounted for some of the profound effects noted, decrease in average cost per case (indicating possible reduction in severity of injury) was consistent with existing literature.

Keywords: Work injuries, Workers' Compensation, prevention

## 1. Introduction

Workplace injuries and their associated economic impact on industry and those injured are a significant problem in the United States today. Each year, millions of occupational illnesses and injuries occur in the United States. Individuals affected by these health problems often become unable to work, or their ability to work is limited by physical impairment. Between 1972 and 1993, employer costs for providing Workers' Compensation rose from \$6 billion to \$57 billion, an annual growth rate of 12.5% (NIOSH, 1999.)

In addition to the direct costs of lost earnings and health care costs related to occupational injury and disease, there are numerous indirect economic costs. Employers sustain some of these, including additional hiring and training costs, disruption of work processes by

workplace mishaps, and the effects of workplace injuries or exposures on the productivity of co-workers who feel at heightened risk. Other indirect costs are borne by the injured workers and their families- for example, reduced income, depletion of savings, and loss of homes. Other costs may fall on the community in the form of increased use of social service programs.

Additionally, there may be substantial non-economic costs associated with injury on the job. Physical and psychological functioning in daily life outside of the work setting may be affected. Loss of self-esteem, self-confidence and alteration in family and community roles may occur.

Monetary costs include worker compensation payouts for medical care associated with the injury; temporary total and permanent partial disability, and other costs derived from litigation. Lost workdays represent

another avenue of indirect cost due to lost productivity for the employer. Anecdotal evidence suggests that many work-related injuries result from the incongruence of the job demands and the specific abilities of the worker.

In the year 2000, a total of 5.7 million injuries and illnesses were reported in private industry [Survey of Occupational Injuries and Illnesses 2000, US Department of Labor (DOL)] resulting in a rate of 6.1 cases per 100 equivalent full-time workers. This represents a decline from a high of 8.1 in 1995, with incremental declines each subsequent year. Of the 5.7 million total injuries, about 1.7 million required recuperation away from work or restricted duty.

In each year since 1994, strains and sprains have been the leading type of injury with more than 4 out of 10 falling into this category. This was followed in declining incidence by bruises/contusions; cuts/lacerations; fractures; back pain and carpal tunnel syndrome. The trunk, including the back, was the body part most affected by disabling work incidents in nearly every major industry division. Overexertion while maneuvering objects was by far the most common disabling event or exposure.

Notable case characteristics for the year 2000, as per the DOL, were as follows: Men accounted for nearly 2 out of 3 of the 1.7 million cases, a proportion somewhat higher than their share (59%) of the hours worked by all private wage and salary workers. Workers aged 25 to 44 accounted for the majority (55%) of the cases as well as the highest percent of hours worked (53%). Operators, fabricators and laborers led all occupational groups in number of cases, accounting for 41 percent of the total. Almost 6 out of 10 workers had at least one year of service with their employer when they sustained their injury, and almost one fourth had over 5 years experience, suggesting that many experienced workers incur lost worktime injuries.

In 2000, over 577,800 musculoskeletal disorders (MSD) were reported, accounting for more than one out of three of the injuries and illnesses involving recuperation away from work. (US DOL does not classify disorders caused by trips, falls or other accidents as MSD.) About 26% of MSD occurred in the services industries, followed by manufacturing industries with 24% and retail trade with 15%.

The median lost workdays – a key measure of severity – was 6 days in 2000, with over one-fourth of cases requiring 21 or more days away from work. Median days away from work was highest for carpal tunnel syndrome (27 days) fractures (20 days) and amputa-

tions (18 days). As per body part, injuries to the wrist resulted in the longest absence from work (12 days) followed by injuries to the knee and shoulder (a median of 10 days each).

## **2. Pre-work screening: Background**

A pre-work screen is a tool used to match Workers' abilities to the physical demands of a particular job. Using a functional job description or actual job site analysis, pre-work screens can be specifically designed to assess the ability of an individual to safely work at the level required. Although the use of such a tool does not guarantee that a particular worker will never be injured on the job, it does assure that the individual, at the time of employment, has the ability to do the job safely. Conversely, these tools can identify obvious, at risk individuals and help ensure proper job placement.

According to the Americans with Disabilities Act (ADA), pre-employment medical exams can be performed after a conditional offer of employment has been made. The condition is that the potential employee passes the exam. However, the screen must accurately represent the job tasks and reasonable accommodation must be considered. Additionally, the screen must be used consistently with all new hires to avoid discrimination.

There are a limited number of published studies that examine outcomes regarding reduction of injury; Workers' Compensation costs; and lost workdays following implementation of pre-work screening programs. However, these few studies have shown promising results. Reimer et al. [6] retrospectively examined effectiveness of a pre-employment worker fitness program in a sample of grocery warehouse workers. The dependent variables were injury rates and compensation costs, and statistically significant differences were found between control and experimental groups. The study concluded that worker fitness evaluations (using the program's methodology) may be effective in reducing injuries and subsequent costs.

Nassau [5], in a 1999 study, sought to determine whether pre-work functional screens were effective in lowering the incidence of work-related back strains, related medical costs and lost workdays within an organization. Interestingly, she found that the frequency of injury was not significantly less in the screened versus unscreened populations. However, the frequency of lost workdays and incurred medical costs as a result of back injury was significantly reduced. She concluded

that the severity of back injury could be decreased by using pre-work screens, and that medical costs and lost workdays would decrease as a result.

Gassoway and Flory [2] compared injury rates, Workers' Compensation costs and turnover rate for nursing assistants at a regional health system. Workers hired prior to and following implementation of the Isernhagen Work Systems pre-work screening program were compared. Their results demonstrated a reduction in injuries requiring medical intervention and a dramatic (nearly 20%) drop in the job turnover rate. Actual Workers' Compensation costs were not significantly reduced although the authors remark that medical costs would have likely been higher if injuries had not been prevented.

Unpublished data from the Isernhagen Work Systems cites results from pre-work screening implementation at Goodyear Tire and Rubber. This included a 12% decrease in lost time days; a \$5,000,000 reduction in workers compensation costs and a 30% reduction in new hire turnover rate.

There is one commonality in these studies that is of interest. That is, the number of injuries was often not significantly altered, although Workers' Compensation costs were still reduced. This leads to the assumption, as pointed out by Nassau, that it may be the severity of injury that is most affected by pre-work screening, which in turn leads to reduced costs and days lost.

### **3. UIC post-offer screening program**

A post-offer screening program jointly developed by the Occupational and Physical Therapy Departments (University of Illinois at Chicago) was first implemented in March 1998. All new hires for physical plant operations have been required to undergo this screening process since that time. Each job classification within the realm of physical plant operations was subject to a job analysis process to identify the essential job tasks and critical physical demands for that particular job classification. All analyses were performed by a trained Occupational or Physical Therapist. Based on these job analyses, short physical capacity screenings were developed.

Over 18 separate job classifications were analyzed, however, three of these jobs comprised 87% of all screens completed between 3/98 and 3/01. These jobs were Building Service Worker (BSW); Driver and Driver Helper. These jobs were generally more readily available and required less skill and previous experi-

ence. Other job classes included but were not limited to electrician, carpenter, plumber and machinist.

The purpose of the screens was to reduce injury frequency, severity and associated Workers' Compensation costs. These goals were important to physical plant administration, as they were keen to curtail Workers' Compensation costs and ensure the safety of their employees. The OT/PT departments were interested in applying a preventive strategy to workplace injuries whilst increasing department revenues. It was hoped that success with this program might lead to similar programs in other university or hospital sectors as well as the private sector.

The screens were based on the Physical Work Performance Evaluation, developed by Deborah Lechner [4] at the University of Alabama. The OT/PT department had purchased this assessment in 1997 and had trained and certified several therapists in its use. This particular evaluation had been chosen in large part because of a published reliability and validity study in a reputable journal. It was felt that this would be essential in defending decisions based on evaluation results, should there ultimately be litigation.

Having received a conditional offer of employment, individuals were scheduled for the screen in conjunction with employee health services. (It should be noted that each client had already passed a pre-employment health exam.) Each screen, depending on the job classification, consisted of from 5 to 7 tasks, each with specific criteria for pass or fail. Failure of any one of these items could result in withdrawal of employment offer. This was left to the discretion of the particular department that was hiring, although in practice nearly all employment offers were withdrawn if any task in the screen was failed. The applicant was free to apply for any other job opening, or to re-apply for the same job classification. Physical plant administration was charged a flat fee of \$80.00 for each screen completed, regardless of the result.

From 3-01-98 through 2-28-01 a total of 712 screens were completed. The fail rate for the totality of screens was unable to be determined due to inadequate archival data. However, a sample of 382 BSW screens was examined yielding a 22% fail rate. A sample of 40 Driver screens yielded only a 2.5% fail rate. This was consistent with the experience of the therapists: that is, the lower skill position (BSW) had a much higher fail rate than job categories requiring more physical skills. This may have been due, in part, to the higher proportion of female BSW candidates (who were found to have higher fail rates in general). Also, applicants for Driver

and Driver Helper appeared to be more physically fit, with greater physical capacity than BSW candidates. The applicant pool was further shrunk for high skill positions requiring previous training and experience (electrician, plumber, etc.). It again was the experience of the therapists that the fail rate was quite low for these positions.

#### 4. Program cost-effectiveness: Methods

Data for this study was obtained from two sources. First, archived data regarding the number of screens for each job category, for each month of the study, were kept by the OT/PT departments. Data regarding documented injuries for each job classification; the date of injury; the date of hire for that individual and the total associated Workers' Compensation costs were obtained from the University of Illinois Office of Claims Management in Champaign, IL. All injured parties were employed by physical plant operations at UIC. Workers' Compensation costs included medical costs; temporary total disability payments; permanent partial disability payments and any monetary awards derived from litigation. These disparate costs could not be separated out for more specific analysis.

A quasi-experimental, retrospective design was utilized. Data was obtained for two distinct time periods: from 3-1-95 through 2-28-98; and from 3-01-98 through 2-28-01. The earlier period was used as a control group and compared to the second group (following implementation of the program on 3-1-98). In this way, a "snapshot" of change could be derived and compared, including number of cases (reported injuries), total costs and mean cost (see Table 1).

Other comparisons were made as well. Since screens for BSW, Driver and Driver Helper comprised 87% of the total screens completed, it followed that examining only these categories in aggregate would provide a better overall picture of program effectiveness (see Table 2).

Tables 3 through 5(b) show these same statistics for each of these three job classifications in isolation. In the Driver Helper job category, there was one case outlier representing 83% of the total cost for that category. Table 5a includes this outlier, while the Table 5b figures were derived after removal of the \$108,402 outlier, to provide a fairer and more accurate comparison.

A second avenue of comparison was to look at the total number of cases incurred by workers that had passed the screen to those cases (from 98 through 01) incurred

Table 1  
Total all job categories

	95 to 98	98 to 01	Percent change
Cases	538	454	Down 18.5%
Total cost	\$3,067,824	\$1,714,188	Down 79%
Mean	\$5702	\$3776	Down 51%

Table 2  
Total for BSW, driver and driver helper

	95 to 98	98 to 01	Percent change
Cases	224	197	Down 14%
Total cost	\$954,379	\$628,271	Down 52%
Mean	\$4261	\$3189	Down 34%
Range	0 to \$119,246	0 to \$108,402	
Median	\$349	\$356	Up 2%

Table 3  
Total BSW

	95 to 98	98 to 01	Percent change
Cases	143	141	Down 1%
Total cost	\$460,177	\$305,947	Down 50%
Mean	\$3218	\$2170	Down 48%
Range	0 to \$87,397	0 to \$85,032	
Median	\$357	\$328	Down 9%

Table 4  
Total driver

	95 to 98	98 to 01	Percent change
Cases	48	36	Down 33%
Total cost	\$440,677	\$191,799	Down 130%
Mean	\$9181	\$5328	Down 72%
Range	0 to \$119,246	0 to \$87,397	
Median	\$338	\$406	Up 20%

Table 5  
(a) Total driver helper

	95 to 98	98 to 01	Percent change
Cases	33	20	Down 65%
Total cost	\$53,525	\$130,525	Up 144%
Mean	\$1622	\$6526	Up 302%
Range	0 to \$30,552	0 to \$108,402	
Median	\$358	\$536	Up 50%

(b) Total driver helper (outlier removed)

	95 to 98	98 to 01	Percent change
Cases	33	19	Na
Total cost	\$53,525	\$22,123	Down 142%
Mean	\$1622	\$1164	Down 39%
Range	0 to \$30,552	0 to \$4820	
Median	\$358	\$447	Up 25%

by workers who had not been screened. This was determined by looking at the date of hire for each injured worker. Those that had been hired on or after 3-01-98 were known to have been screened. Those hired before this date were known to not have undergone pre-work screening. In this way, comparisons could be made

Table 6  
Total for BSW, driver and driver helper-98 to 01

	Those screened	Those not screened
Cases	17	180
Total cost	\$10,833	\$617,438
Mean	\$637	\$3430
Range	0 to \$3078	0 to \$108,402
Total # screens/passed	343	
Rate of injury	0.05	

Table 7  
Total for BSW-98 to 01

	Those screened	Those not screened
Cases	14	127
Total cost	\$5171	\$300,776
Mean	\$369	\$2368
Range	0 to \$1150	0 to \$85,032
Median	\$288	\$337
Total # screens/passed	245	
Rate of injury	0.057	

Table 8  
Total for driver-98 to 01

	Those screened	Those not screened
Cases	1	35
Total cost	\$231	\$191,568
Mean	\$231	\$5473
Range	\$231	0 to \$87,397
Median	\$231	\$411
Total # screens/passed	41	
Rate of injury	0.024	

Table 9  
Total for driver helper

	Those screened	Those not screened
Cases	2	18
Total cost	\$5431	\$125,094
Mean	\$2716	\$6950
Range	\$2353 to \$3078	0 to \$108,402
Median	\$2716	\$447
Total # screens	57	
Rate of injury	0.035	

within a specific job category, including injury rates. All injuries did occur between 3-01-98 and 2-28-01. It should be noted that workers who had been screened between 3-01-00 and 2-28-01 were not included to allow for at least one year of exposure to risk of injury. In fact, the number of cases was not altered due to this adjustment, although the Total # screens/passed category was, of course, lowered. The net effect was to raise the calculated rate of injury.

The actual number of workers in the Total#screens/passed pool was determined by applying the 22% fail rate to the total number of BSW (Table 7) screened from 3-01-98 to 2-28-00 ( $314 \times 0.78 = \text{Total\#screens/passed}$ ). The 2.5% fail rate was applied

similarly to the Driver category (Table 8). As there were no statistics available for the Driver Helper category (Table 9), a 2.5% fail rate was applied here as well, chiefly because this was a job more similar to Driver, and because it was less likely to be failed than BSW (in the experience of the therapists). These three totals were then summed and used in the aggregate category (Table 6). Note that figures for cases and total costs are not directly comparable, as the total pool of those not screened is unknown, and undoubtedly would be much larger than the pool of those screened.

## 5. Costs

The costs associated with the pre-work screening program were calculated so that they might be compared to savings derived from the program. Costs were considered to be the dollar amount paid by physical plant administration to the Occupational/Physical Therapy Departments, plus the therapists' salary for the time spent doing the screens. (\$80 per screen + \$25 therapist's time = \$105.) This represented costs to the university as a whole. Savings were considered to be any reduction in Workers' Compensation payouts for the 98 to 01 period compared to the 95 to 98 period.

An effort was made to account for any other factors that might result in a cost reduction. There were no overt policy changes within physical plant or claims management administration identified that would yield such a result, nor were there any new preventive measures undertaken that might cause such an effect. There were no changes in the law regarding Workers' Compensation. UIC safety personnel interviewed for this paper commented that Workers' Compensation claims were no longer being routinely paid by Workers' Compensation Administration, especially in 2001. That is, claims might be routinely denied and cases ultimately closed unless the injured worker was aggressive in pursuing his claim. This would certainly result in cost reduction. However, it would be impossible to realistically assess a dollar value to this effect. Thus, the following figures represent a best case scenario for cost savings (Table 10). As the changes are dramatic, it would be safe to assume that the screening program did account for a significant portion of the savings.

The calculations were made for savings in cases from all job categories screened, and for cases from the BSW, Driver and Driver Helper job categories aggregated. The aggregate group is felt to represent the most realistic assessment as it accounted for 87% of the total screens completed.

Table 10  
Cost savings analysis

	All jobs	BSW, Dr, DH
# of screens	712	622
Total cost of screens	\$74,760	\$65,310
Total WC cost reduction	\$1,353,636	\$326,108
\$ saved per \$ spent	\$18.11	\$4.99

## 6. Discussion

The first group of data (Tables 1 through 5b) compares incidence of injury and associated costs in two distinct time periods: that before and following implementation of a pre-work screening program.

Total costs were found to decrease dramatically in both BSW and Driver categories. The Driver Helper category costs rose dramatically until one high-end outlier was removed, after which an equally dramatic decline was observed. However, it is difficult to ascribe all these savings to the screening program alone. It may be that claims have generally been less routinely paid out. There was a significant decline in the total number of injuries (Table 1) but this decline becomes minimal when the BSW category is singled out (Table 3). As this job category is where the most significant effect of the program is expected, it is difficult to claim that the program significantly reduces incidence of injury.

Mean costs per case were found to be substantially reduced in general, again inversely affected only by the Driver Helper outlier. This seems to point to greater program effects, as one would expect mean costs to be similar once a claim has been made and accepted. However, it may be that each subsequent claim or request in a particular case (i.e. for a surgery or physical therapy) might be met with renewed scrutiny and barrier to payment. If this were the case, it could account in part for mean costs being driven down.

Median costs were found to decline minimally for BSW, and to actually rise for Driver and Driver Helper, even after removal of the outlier. As this statistic generally softens the effects of outliers, this may indicate no true decline in average cost per case. Still, the fact that mean cost was so significantly higher from 95 to 98 lends credence to the supposition that severity of injury and high cost cases were being prevented (as concluded by Nassau).

The second group of data (Tables 6 through 9) essentially compares mean cost per case of those injured workers who had been screened versus those who had not been screened, and whose injuries occurred during the same period of risk. Median cost was also examined for the individual job categories. These statis-

tics certainly bear considerable weight, as both groups should have been equally affected by external factors. Yet, dramatic declines in mean cost per case are seen in the screened versus unscreened groups for BSW and the aggregate category (Tables 7 and 6). This almost certainly represents program effects. Mean costs for Driver and Driver Helper, although dramatically reduced, rely on too few cases for them to be considered statistically significant.

Median costs were also substantially reduced in the BSW job category. Median costs were found to be lower for Driver (although higher for Driver Helper), yet again, case incidence was so low in these categories, it is difficult to ascribe these changes to program effects.

Figure 1 displays mean cost per case for those screened versus those not screened, for BSW and aggregate categories.

Tables 6 through 9 also show the calculated rate of injury for each job category and in aggregate. The initial idea had been to compare injury rates for those screened versus those not screened. However, it became quite difficult to ferret out the exact number of employees at a given time. Each job category is a combination of full-time employees and 900-hour temporary employees. Although both groups were screened, the obvious frequent turnover of the temporary workers made calculation of a realistic rate of injury impossible as a reliable number for the injury rate equation denominator was lacking. Thus, the national rate of injury for the service-producing sector (5.1/100) was selected for comparison. Figure 2 compares each job category to the national rate.

Here we see an injury rate below the national average in all but the BSW category, where rates are slightly higher. The aggregate category rate is essentially equal to the national average, perhaps again indicating that injury rates were probably not affected by our program. It should be noted that rates for Driver and Driver Helper are derived from a case numerator of one and two respectively. Thus, it is difficult to say if these rates would hold up for a larger sample, especially when the larger BSW pool yields a rate in line with national averages.

## 7. Policy implications/ethical considerations

Screening tests in general have typically sparked debate regarding their ethical and legal aspects. Himmelstein [3] points out that, from a legal point of view, screening programs hold potential for significant dis-

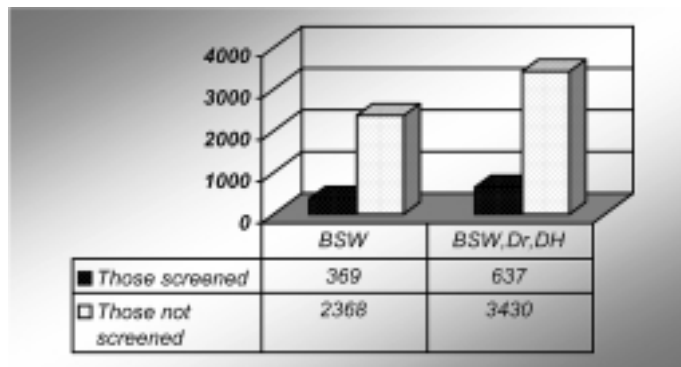


Fig. 1.

crimination against legally protected groups. For example, the use of muscle strength testing or screening tasks that require significant strength will probably systematically discriminate against women. In fact, the majority of failed screens in our program were women.

Still, the ethical implications of predictive screening clearly depend on what is done with the information. Himmelstein again points out that if the information is used only to make a safe job placement, and this placement does not affect the individual's salary or future job prospects, then such programs may have a net social benefit as it may lead to true prevention of injury and disability. If the tests are used merely to reduce employer liability, the ethical and legal limitations may outweigh any perceived benefits. Additionally, it has been noted in the literature that the majority of costs associated with work injuries are derived from the small proportion of those that will suffer with (back) symptoms for 6 months or more. Thus it may be that screening programs are not sensitive enough to identify these outliers alone, and needlessly eliminate individuals from the worker pool.

In a study of preventive approaches to back injury, Snook et al. [7] found that worker selection and training in safe lifting were not effective controls for low back injury. It was determined that a worker was three times more likely to sustain a low back injury if exposed to excessive manual handling tasks. He concluded that ergonomic re-design of tasks to reduce manual handling exposure represented a partial control for low back injuries. Of course, many large corporations have instituted their own ergonomic programs to reduce injuries, however, the OSHA ergonomic standard issued in November 2000 would have required businesses at all levels to implement ergonomic standards. These standards were disapproved by President Bush and Congress in March 2001. Thus ergonomic controls,

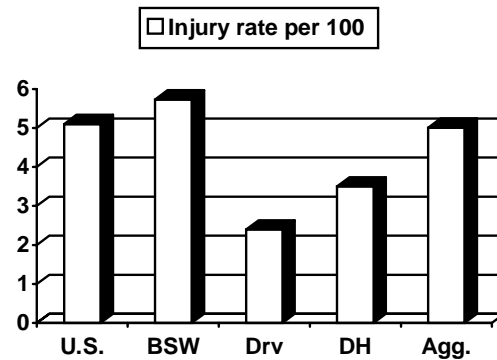


Fig. 2.

lacking regulatory weight, may not, by themselves, be an ideal control for injury prevention.

As previously noted, pre-work screening programs are legal when implemented within the guidelines of the ADA. It would be naïve to suggest such programs would not be implemented based on ethical considerations, should such programs be proved effective in reducing Workers' Compensation costs. In fact, lacking legal disincentive, it would seem inevitable that screening programs would proliferate. The current dearth of conclusive research on the effectiveness of such programs may account for the fact that they are not more widely used.

Based on the review of the literature and the promise shown in this study, this author is in favor of the use of pre-work screening with some caveats. First, testing should be applied to all candidates as stipulated by the ADA. Second, studies should be routinely implemented along with the program itself to increase the available literature to either support or disprove the effectiveness of such programs. Finally, screening results should be used to match an individual with an appropriate job, not simply deny them a specific one. Ideally,

individuals who fail screenings might be referred for appropriate training to allow for successful screening in the future. However, given the lack of employer obligation in this respect, such action might not likely be deemed reasonable by the employer.

The UIC pre-work screening program remains in operation. More data collection and analysis is currently being planned regarding its cost-effectiveness. Worker characteristics such as sex, BMI, grip strength and others are being examined for their predictive value of screening failure.

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