



Final Report to NIOSH on
The Impact of OSHA Inspections on Manufacturing Injuries

January 31, 2003

Submitted by
John Mendeloff—Principal Investigator
Graduate School of Public and International Affairs
University of Pittsburgh
Pittsburgh, PA 15260

and

Wayne B. Gray—Principal Consultant
Department of Economics
Clark University
Worcester, MA
National Bureau of Economic Research
Cambridge, MA 02138

National Institute of Occupational Safety and Health Grant R01-OH03895-03

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List of Abbreviations

BLS—U.S. Bureau of Labor Statistics

DAW—days away from work injuries, a component of LWD injuries

LWD—lost workday injuries

OSHA—United States Occupational Safety and Health Administration

RWA—injuries with only restricted work activity, a component of LWD injuries

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Abstract

This study examines the injury prevention impact of OSHA inspections at manufacturing plants from 1992 to 1998. The data come from matching establishments in the OSHA IMIS and the BLS Survey of Occupational Injuries and Illnesses. We matched 16,036 establishments and obtained a sample of 50,076 observations of annual changes in injuries. The study carries out 3 main sets of analyses. The first compares outcomes in 1992-98 with those from very similar studies that examined 2 earlier periods: 1979-85 and 1987-91. The second examines how the characteristics of workplaces and inspections affected the impact of inspections in the 1992-98 period. The third disaggregates both interventions and outcomes to examine how both inspections and the citation of particular violations affected particular injury event types.

The comparison across periods found that the sizable effects of inspections found in 1979-85 had declined steadily over time. Depending on what model was used, the reduction in lost workday (LWD) injuries from an inspection with a penalty was either 15% in the first period, 8% in the second period, and 1% in the most recent period; or 22% in the first period, 15% in the second period, and 8% in the most recent period. These reductions were seen across all size classes of establishments and across all inspection types. We also looked separately at the two components of the LWD rate: injuries with days away from work (DAW) and injuries with restricted work activity only (RWA). In all 3 periods we found that inspections had had no impact on RWA injuries and thus that all of the decline in effectiveness had occurred among DAW injuries. We examined several candidates for explaining the declining impact, but were not able to arrive at a satisfactory explanation.

Our study of the 1992-98 period showed that the only clear evidence of effectiveness occurred among establishments with fewer than 100 workers. Inspections at unionized workplaces were found to lead to increases in the numbers of RWA injuries, probably because of changes in management practices that the inspections induce. Surprisingly, health inspections led to sizable reductions in injuries while safety inspections did not. Complaint inspections showed more evidence of impact than programmed inspections, but we found no robust evidence that inspections in particular industries were particularly effective.

The third set first categorized DAW injury events into those that were more or less preventable through enforcement of OSHA standards. Contrary to expectations, we found that injury types not addressed by standards were reduced by inspections more than those that were; for example, injuries due to "bodily reaction and exertion" were affected by inspections, but injuries due to getting caught in machinery were not. We also looked at the effects of citing 5 frequently violated standards. Among them, only citations of the general personal protective equipment standard led regularly to injury reductions. We concluded that OSHA inspections have effects not only through a detection/correction mechanism, but also through inducing employers to pay more attention to safety problems as a whole.

Significant Findings

In our proposal we stated that our major specific aims included the following:

- 1) To replicate earlier studies to see whether the average effects of inspections (with penalties) are similar in the most recent period to effects found earlier.
- 2) To examine additional control variables that will allow us to investigate the impact of inspections at particular subsets of workplaces
- 3) To develop a method for linking particular violations to particular injury types that could be prevented by the abatement of those violations. We will then test whether those effects occur. More broadly we will examine whether changes in injuries following inspections disproportionately involve particular types of injuries. These analyses should help us understand *how* OSHA inspections have an effect and what model best explains these outcomes.
- 4) To examine the effects of newly promulgated OSHA safety standards on injuries. In particular, we planned to explore whether the injuries addressed by the new standards decline more at inspected compared to uninspected plants.
- 5) To assess particular enforcement strategies employed in different states by state OSHA agencies and by some of the OSHA Area Offices.

Below we briefly review our progress in addressing those aims.

Specific Aim 1: Comparing the Effects of Federal OSHA Inspections in 1992-98 with the Effects in Earlier Periods

For inspections in 1992-98 in federal OSHA states, we were able to compare our findings with those from two analyses that used the same basic methodology to estimate inspection effects in Federal OSHA states for 1979-85 and for 1987-91. We found that the average effects of inspections with penalties declined by about 7% from the first period to the second period and another 7% from the second period to 1992-98. These represented a decrease in the average preventive effect of penalty inspections from about 15% of injuries in the first period to a reduction of 1% in the most recent period or, using an alternate model, from 22% to 8%.

The decreases in effectiveness occurred across all size classes of establishments. We also looked separately at the effects of inspections on injuries with days away from work (DAW) and injuries with only restricted work activities (RWA). Lost workday injuries have two categories—injuries with days away from work (DAW) and injuries with only restricted work activity (RWA). We found that, even in the earliest period, there had been no effects on RWA injuries. Evidence of prevention was found only when looking at DAW injuries. The reasons for this difference are not clear, but it very likely involves the practices that employers adopt subsequent to inspections rather than the differential effects of the inspection itself.

We discuss and test several different possible explanations for the declining impact of federal OSHA inspections. These include the declining marginal effectiveness of repeated inspections, the growing obsolescence of OSHA standards, and improvements in management safety programs. We do not arrive at any strong conclusions.

Specific Aim 2: To examine additional control variables that will allow us to investigate the impact of inspections at particular subsets of workplaces

Unlike our analyses comparing the effects from 1979 through 1998, which were limited to federal OSHA inspections, the analyses presented here for the 1992-98 period included both federal and state plan inspections.

During the period from 1992 to 1998 inspected establishments where penalties were levied experienced declines in reported lost workday injuries compared to establishments without penalty inspections. However, although that decrease was statistically significant for DAW injuries (at the 0.10 level), it was not significant for the larger category of LWD injuries. When we looked at 4 size categories, the effect of penalty inspections was significant (at the 0.10 level) for LWD injuries only for establishments with fewer than 100 workers.

Inspections without penalties had no impact on injuries. In fact, compared to workplaces without inspections, the effect of an inspection without a penalty was actually to increase the number of reported injuries. The effect was usually about 1/3 to 2/3 the size of the IPENX coefficient (on average about $\frac{1}{2}$). It is important to note the implication that if 2/3 of inspections levy penalties, as they currently do, the overall impact of those inspections would have to be reduced by 1/6 ($\frac{1}{3}$ times $\frac{1}{2}$) to account for the contrary effect of not levying penalties. This offset will be greater to the extent that the average employment size is greater at the plants where inspectors do not assess any penalties.

Establishment Size

The preventive effects of penalty inspections are greater at smaller workplaces. The negative coefficients become statistically significant when the sample is limited to establishments with less than 100 workers; and remain significant when we look at all establishments with less than 250 workers. At workplaces above that size, inspections show no sign of a preventive effect. The effect on DAW injuries declined monotonically with increasing size.

The Role of Unions

We examined the impact of inspections at unionized workplaces and found that the preventive effects there were smaller than at non-union workplaces, although only the effect on RWA injuries was statistically significant. At unionized workplaces, penalty inspections were often followed by increases in RWA injuries that more than offset any decreases in DAW injuries

Effects of Different Inspection Types: Programmed, Complaint, Health and Safety

Oddly, when we looked separately at inspections designated as "safety" or "health" and at those with and without penalties, the only ones to have clear preventive effects were health inspections with penalties. A parallel review of programmed and complaint inspections found that only complaint inspections with penalties had any effects. In both cases the coefficients were on the order of 2% a year for 4 years.

We also combined all 4 types above so that, with those with and without penalties, we had 8 different variables. The only one with a clear preventive effect on LWD injuries was programmed health inspections with penalties. It was followed by complaint health inspections with penalties.

Specific Aim 3: The Effect of Penalty Inspections on Different Types of Injuries

We examined the effects of inspections with penalties on different types of injuries. Based on data analysis and discussion with OSHA officials, we first tried to distinguish whether OSHA standards addressed a sizable proportion of the injuries in these categories. Those where the presumption was that the injuries were addressed included

- A1—struck by (BLS event code 02)
- A2—caught in (code 03)
- A3—falls from heights (code 11)
- A4—eye abrasion (code 053)
- A5—caught in machines (032)
(subcategory of A2)
- A6—toxic substances (code 31-349)

The presumption that injuries were not addressed by OSHA standards was made for these injury categories:

- B1—exertion (code 2 except 215)
- B2—struck against (code 02)
- B3—fall, same level (code13)

Collectively, these event codes account for 95% of all injuries with days away from work (DAW) in manufacturing. This analysis was limited to DAW injuries because they are the only ones for which BLS collects information about injury characteristics.

With the help of OSHA staff, we classified injury event categories into types that were judged more or less likely to be addressed by OSHA standards. One model of inspection effects would suggest that inspections should have effects only on injuries that were related to violations of standards. We tested this model using DAW data, because it is the only type for which we have the required detail on injury type.

Contrary to the expectations based on this model, we found the biggest effects of inspections on overexertion injuries (about an 8% reduction), followed by “struck against” injuries (about 6%). These effects were statistically significant at the 0.05 level. The only other effects that were statistically significant, this time at the .10 level, were the effects on toxic substance injuries and the effects on eye abrasions (both about 4%). We also looked specifically at “caught in machine” injuries and found that the coefficient was positive although the ‘t’ statistic was just below one.

These findings indicate that OSHA inspections do have impacts beyond the scope of injuries directly addressed by standards. Therefore, other mechanisms must be at

work. Apparently, some employers make broader efforts to improve their safety programs subsequent to being penalized.

The Effect of Citing Particular Violations on Injuries

Using DAW injury data from all states, we also looked at the effects on the number of injuries of a particular event type from citing particular violations, rather than from having an inspection with a penalty. (In this case we limited the sample to establishments in federal OSHA states because many state plan programs have additional standards that federal OSHA does not have or use different coding schemes.) These models included 5 common violation types in a single regression on one of the injury event types. The violations included: the general machine guarding standard, the general personal protective equipment (PPE) standard, the electrical wiring standard, the forklift truck standard, and the fire extinguisher standard.

Our major finding was that the only one of these five standards that consistently showed signs of impact was the citation of the general provision of the personal protection standard.

Specific Aim 4: To examine the effects of newly promulgated OSHA safety standards on injuries.

We did not carry out the original plan to investigate the effects of newly promulgated OSHA standards by looking at the impacts when violations of these standards were cited. However, we did carry out a study that compared the projected effects of OSHA safety standards with actual injury rate patterns following the adoption of standards. The study found that OSHA projections of the prevention impacts were generally substantially higher than we would estimate on the basis of the injury data. We examined the reasons for the disparity and methods for reducing them.

Specific Aim 5: To assess particular enforcement strategies employed in different states by state OSHA agencies and by some of the OSHA Area Offices

We compared the average effects of inspections and of different types of inspections in federal OSHA and in state plan states, but found few differences that appeared consistent or statistically significant. To this extent, it appears that inspections are “at least as effective” in state plan states. In addition, State Plan states do carry out considerably more inspections; consequently, equivalence in impact per inspection might translate to greater overall impact in the state plan states. We also looked separately at the 7 state plan states for which we had the largest number of observations. We found some evidence of differences, but the evidence was not very strong.

Usefulness of Findings

As we stated above, three of the main goals of this project were to a) identify the effects of OSHA inspections on injuries in manufacturing; b) identify the types of inspections which had preventive effects and the types of workplaces where they occurred; and c) to identify which types of injuries were being prevented and which citations had the most effect on them.

Although we present below several suggestions for improving the effectiveness of inspections, perhaps the major finding of this study is that the preventive effect of inspections in manufacturing has declined substantially from earlier studies covering 1979-91 to the period we examined, 1992-98. One implication may be that the nation needs to supplement, and perhaps partially replace, the traditional OSHA enforcement approach. We should note that OSHA has, in fact, adopted a new method for targeting programmed inspections. It now relies on data that it collects through the OSHA Data Initiative to identify individual establishments that have experienced above average injury rates and attempts to target inspections at these facilities, while also encouraging them to make use of OSHA's consultation program.

Another cautionary note is that inspections that fail to cite serious violations or levy penalties appear to lead to increases in injuries. Perhaps the "clean bill of health" fosters a managerial attitude that safety concerns can be de-emphasized. OSHA should consider the possibility that its inspections can have perverse as well as preventive effects as it designs its enforcement strategy.

The finding that penalty inspections had their greatest impact at workplaces with fewer than 100 workers could lead to a greater focus there. More generally, the implication of that finding may be that the current effects of inspections are greatest where OSHA has inspected less frequently in the past and where firms lack a lot of internal safety resources. Perhaps more focus outside of the traditional manufacturing and construction sectors would be appropriate. The finding that inspection effects are not necessarily limited to hazards covered by standards provides some assurance that devoting more inspections to workplaces that have relatively few of those could still be productive. However, OSHA must recognize that, although the percentage impact may be greatest there, it still may be preventing fewer injuries than it did when it had similar effects at workplaces that were larger or that had larger numbers of injuries.

The finding that health inspections in manufacturing were more effective than safety inspections in preventing injuries deserves special attention. More work needs to be done to understand the reasons for this greater effectiveness. However, the finding does cast a new light on health inspections. Some have expressed disappointment that they find cases of overexposed workers in only a small percentage of inspections. But our finding suggests that the benefits of health inspections are not limited to effects on occupational diseases.

Finally, our findings provide some support for resisting changes that would lead to cutbacks from the present level of complaint inspections.

Scientific Report

Background for the Project

The Occupational Safety and Health Administration's (OSHA) activities represent a major public intervention to reduce occupational trauma. OSHA's major instrument is a program of inspections geared to achieve compliance with its set of safety and health standards. Although OSHA has other tools besides inspections—e.g. new standards can make equipment manufacturers adopt safer designs, while OSHA's consultations can help employers learn how to work more safely--the inspection program remains its most significant intervention.

The manufacturing and construction sectors are the focus of a large majority of OSHA's inspections. Because inspections in manufacturing are more time-consuming than those in construction, the resources that OSHA devotes to manufacturing far exceed those devoted to any other sector. The 1997 BLS Survey reports that manufacturing workers suffered over 900,000 lost workday injuries and illnesses, 31% of the private sector total. Although reported injury rates had been declining during the mid-1990s in manufacturing and other sectors, there was a continuing need to learn about how well this enforcement program was working and, in particular, whether certain kinds of inspections worked better for certain types of problems at certain types of firms.

Yet, during the first two decades of OSHA's existence, researchers made very little progress in gaining insight about its overall impact and about what worked best with what types of problems. In 1993, a review that asked "What has OSHA learned in over 20 years about 'what works' and what works best in enforcement policy" concluded that the answer was "not too much." [Mendeloff, 1993]

A number of studies had tried to examine the impacts of OSHA inspections in the manufacturing sector [Smith, 1979; Mendeloff, 1979; Viscusi, 1979; McCaffrey, 1983; Bartel and Thomas, 1985; Viscusi, 1986; Ruser and Smith, 1991]. For the most part, these studies found little or no effect. Most used highly aggregated analyses that related industry injury rates to the probability of and expected penalty from inspections. A few relied on annual BLS Survey data that included a variable about whether the workplace had been inspected during the year, but that did not include any information about what kind of inspection it had been or what its outcomes were. Some studies, like Cooke and Gautschi's [1981] study of paper mills in Maine, looked at individual establishments but were limited to a small number in a particular industry.

Studies with poorly measured variables and weak research designs tend, on average, to underestimate program effects. A series of studies by Scholz and Gray [1990, 1993, 1997] and Gray [1996] were the first to link establishment-level data on injuries from the BLS Survey with the inspection data on establishments in OSHA's IMIS. This linkage allowed them to examine the injury trends at inspected and uninspected establishments and to see how they differed depending upon the type of inspection and its outcome. Looking at inspections in manufacturing from 1979 to 1985, they found that inspections with penalties reduced the number of injuries by an average of 22% in the

several years following the inspection. In contrast, inspections without penalties had no impact. Gray's analysis [1996] of more recent experience (1987-91) found the same pattern for inspections with and without penalties, although the average impact of the former in this sample was 15%. He also concluded that the effects were larger at the smaller firms in the sample, that planned inspections had greater effects than complaint inspections, and that very large penalties had no greater effect than moderate penalties.

A New Focus and Improved Data

Our research proposal called for building on the earlier contributions of Gray and Scholz. For various reasons, their studies left a great deal of the richness of the data sets unexplored. With the first data set, created with funding from the National Science Foundation, the central research issue was the development of a theoretical model that explained why firms reacted to the regulatory agency in the way that they did. The exploration of the safety and health implications of the data was not the primary concern. In the second data set, the funding level did not support anything more than a replication of the earlier study. In contrast, our commitment was to exploring the value of this data set to those in the safety and health field. In addition, we noted that the merged data set will remain at the Bureau of Labor Statistics, available for use by other qualified researchers

In addition, there had been major improvements to both the BLS and OSHA datasets. These allowed us to perform analyses that could not have been done before. Beginning in 1992, the BLS Survey began collecting detailed information about the injuries and illnesses that resulted in at least 1 day away from work. This information includes data elements about the injury—the nature of injury, part of body, source, and event/exposure, and the number of days off work—and about the injured worker—sex, race, age, tenure with the employer, and occupation. The availability of these data elements allowed us to examine a number of important new issues which we list below under “Contributions.” For example, we could see whether there was any linkage between the particular violations that OSHA cited at a workplace and the types of injuries that increased or declined there.

The major improvement in the OSHA IMIS data was that it now included inspections from all states, not just the 29 states where federal OSHA is responsible for enforcement. Prior to 1990, a number of the 21 states which operated their own enforcement programs under the OSH Act (so-called 18(b) states) did not submit data to the IMIS. This change not only added to the sample size and allowed us to have a national data set, but it also allowed comparisons of inspection programs in federal OSHA and 18(b) states. Because there is probably more variation in enforcement strategies between 18(b) states and federal OSHA than there is among the federal OSHA regions, we could carry out better tests of whether these different strategies had an impact on injuries.

We emphasized that the dataset would be available to other researchers. We think that it will be useful not only for research about OSHA enforcement, but also for injury epidemiologists. For example, the NIOSH report on “Traumatic Occupational Injury

Research Needs and Priorities” (NIOSH, 1998) called for research that would “Take advantage of variations in injury rates between individual worksites doing similar tasks to begin to assess the role of ‘best practices’ and other factors that contribute to lower injury rates in some work environments.” Our data set allows the identification of worksites within the same detailed industry which have consistently reported high or low injury rates. It allows researchers to get insights about whether particular types of injuries accounted for the differences. Information on union status, plant size, relation to a larger firm, and plant location can all be examined. (Despite its potential value, we did not have time to examine the demographic data on the employment tenure, age, sex, and race of the injured workers. Although we lacked denominator data at the worksite level, these data might still prove useful in conjunction with industry-level data.)

Specific Aims

This research project prepared and then analyzed a dataset which combines establishment level injury and illness data from the Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses with establishment-level inspection data from the Occupational Safety and Health Administration's (OSHA) Integrated Management Information System (IMIS). The linkage included manufacturing plants which had been in the Survey for at least 3 continuous years from 1992 to 1998. Similar datasets for earlier years have produced the most credible evidence of OSHA's impact on reducing lost workday injuries.

Our effort can be distinguished from earlier ones in three ways. First, we were working with a richer data set. Since 1992, the BLS Survey has collected data elements that allow us to characterize both the injuries and the injured worker when the injury caused days away from work. In addition, since 1990 the OSHA inspection data includes results from every state, allowing comparisons of sharper variations in enforcement strategy. Second, earlier efforts were limited in their objectives and funding. We provided a much fuller exploration. Third, although the first matched data set was created almost a decade ago, only the creators had access to it. The data set we created resides at BLS and is accessible by other researchers approved by BLS.

Our broad objectives were:

- 1) To provide information to federal and state OSHA officials that will prove useful to them in improving the effectiveness of their current activities.
- 2) To provide an initial model for how these data can be used to shed light on several new aspects of occupational safety and health policy.

Our major specific aims included the following:

1. To replicate earlier studies to see whether the average effects of inspections (with penalties) are similar in the most recent period to effects found earlier.
2. To examine additional control variables that allow us to investigate the impact of inspections at particular subsets of workplaces
3. To develop a method for linking particular violations to particular injury types that could be prevented by the abatement of those violations. We then tested whether those effects occur. More broadly we examined whether changes in injuries following inspections disproportionately involve particular types of injuries. These analyses should help us understand *how* OSHA inspections have an effect and what model best explains these outcomes.
4. To examine the effects of newly promulgated OSHA safety standards on injuries. In particular, we planned to explore whether the injuries addressed by the new standards decline more at inspected compared to uninspected plants.
5. To assess particular enforcement strategies employed in different states by state OSHA agencies and by some of the OSHA Area Offices.

Methodology

1) Data Sources

a) OSHA's Integrated Management Information System (IMIS)

The IMIS contains records of all inspections that the agency has conducted. In addition, since 1990, it contains inspection data from all of the states which operate their own enforcement programs under Section 18(b) of the OSH Act ("state plan" states). In 1990, California and Washington became the last states to join the IMIS system. (The 29 federal OSHA states are Alabama, Arkansas, Colorado, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Kansas, Louisiana, Massachusetts, Maine, Missouri, Mississippi, Montana, N. Dakota, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, S. Dakota, Texas, Wisconsin, and W. Virginia.)

In addition to extensive information about the findings of the inspection, the IMIS contains a limited amount of information about the firm. The IMIS contains the name and address of the establishment (as well as its mailing address, if it is different), the SIC code, the number of its workers "affected by the inspection," the number of workers it had on site, and the total number of workers "controlled by the employer." It includes information on whether there was a union representing the workers, whether an employee representative accompanied the OSHA compliance officer during the inspection, whether the inspection was "partial" or comprehensive, the type of inspection (e.g., programmed, complaint, etc.), and its duration.

The IMIS also includes a listing of the specific violations cited during the inspection, their gravity (e.g., willful, serious, other), and the penalty proposed for each one, if any.

In general, the quality of IMIS data is very high for data elements that have traditionally been used by the agency to assess Area Office performance and which have clear legal significance. These elements include information about violations cited and inspection type. Other data elements--notably the detailed sampling results for toxic substances when the results are below the legal limits--are often omitted from the IMIS. The data for the SIC code have generally proved to have a high level of accuracy.

In addition to inspections from 1992-98, we also included IMIS inspection data from 1990 and 1991 in order to be able to estimate the lagged effects of inspections on injury rate changes in 1992-93 and 1993-94. For this entire 9 year period, there were 218,800 manufacturing inspections in the IMIS database. That figure includes data from all states, including those with state plans.

b) BLS Survey of Occupational Injuries and Illnesses

The Survey, carried out by the Bureau of Labor Statistics since 1972, is the main source of information about the frequency of non-fatal workplace injuries and illnesses. It categorizes injuries in several ways: cases with days away from work, cases with "restricted work activity," only, and cases with no work restrictions, but with medical

attention beyond first aid. The first two categories together are called “lost workday” injuries. All three comprise the “total recordable” rate.

Data Quality

Many questions have been raised over time about the accuracy of the data reported in the Survey. (National Research Council 1987) Enhanced auditing by OSHA of recordkeeping quality in the late 1980s and 1990s generated a number of very large and well-publicized fines for underreporting. As a result, recordkeeping is probably better now than it was in the 1980s. Researchers have observed that data on the numbers of days lost also appeared to be underreported, in part because employers give low figures when they are asked to estimate the expected return date for workers still off work. [Oleinick et al, 1992] As a result, BLS reports now focus on the median duration of injuries, which is less affected by inaccuracies in the upper tail of the distribution.

It is probably reasonable to assume that more serious injuries are less likely to be underreported or misreported. One reason is that the reporting definitions are simply less ambiguous. For example, identifying an injury with “days away from work” is more straightforward than identifying injuries requiring more than first aid or where the work is restricted. In recent years, many firms, especially in manufacturing, have instituted aggressive programs to keep injured workers on the job, a change reflected in the increasing share of “restricted work” cases in the lost workday totals. Because of this trend, the lost workday measure is more robust measure than either of its components.

A more fundamental factor affecting the validity of injury reports as a measure of workplace risk is the role of economic incentives. Research has shown that reported non-fatal injuries tend to increase when compensation benefits become more generous. [Butler and Worrall, 1993; Ruser, 1993] In general, we do not expect this factor to confound comparisons of changes in injuries experienced by inspected and uninspected firms, except in the unexpected case where they are substantially more or less prevalent in different states. We include dummy variables for states as a method to control for possible bias.

The Survey shows that in 1994 illnesses constituted 10% of the total number of injury and illness cases with “days away from work” in manufacturing. For non-lost workday cases, and cases with only restricted work activity, the figures were 16% and 15%, respectively. As the BLS notes, illnesses due to long-term exposures are often very difficult to link to the workplace and are probably underreported in the Survey. The bulk of illnesses that are reported involve either dermatitis or, recently, carpal tunnel syndrome. For this reason, our analyses of lost workday cases are limited to injuries; however, our review of injury types for DAW cases includes many illnesses due to environmental exposures.

Resulting Data Sets

Since our analysis focuses on injury changes, two consecutive years of BLS data are needed to generate one observation for analysis. Table 1 describes the chief features of our data set, as well as the comparable characteristics of the data sets used in the

analyses for earlier periods. The original Scholz and Gray data set was restricted to those manufacturing establishments which had BLS injury data available for all 7 of the years from 1979 and 1985. Later in the 1980s there were substantial cuts made in the size of the BLS Survey sample. Because of these cuts, when it came time to prepare the 1987-1991 data set there would have been very few establishments with 5 continuous years of BLS data available, and these would have been almost exclusively the largest establishments. Therefore it was decided to broaden the sample size, including all manufacturing establishments with at least 2 consecutive years of BLS Survey data. This change also helped compensate for the tendency of multi-year plants to become increasingly large, so that the size distribution did not become excessively skewed towards the largest establishments. For the period from 1992 to 1998, we included all establishments with 3 or more consecutive years of BLS Survey data. The full sample has 50,076 observations of a change in injuries at an establishment from one year to another. These observations come from 16,036 establishments.

If we had instead insisted on 7 years of BLS Survey data, the size distribution would have been seriously skewed: of the 860 federal state establishments with 7 years of data, only 21 had fewer than 100 employees and only 60 had fewer than 250. Even if we look at the entire sample from all states and focus on the number of observations, rather than on the number of establishments, there were only 324 observations in this size group with 7 years of data, as the Table below indicates. This paucity of observations would have precluded any analysis of OSHA's impact in those smaller establishments which receive the majority of OSHA inspections.

Table A
Observations from Establishments with Different Numbers of Years in Sample

<u>Years</u>	<u><100</u>	<u>100-249</u>	<u>250-499</u>	<u>>499</u>	<u>Total</u>
3	4,081	2,504	1,170	1,095	8,850
4	3,699	3,528	2,224	1,633	11,084
5	2,598	3,158	3,243	2,492	11,491
6	1,212	1,735	3,092	3,362	9,401
7	<u>324</u>	<u>556</u>	<u>2,180</u>	<u>6,390</u>	<u>9,450</u>
	11,914	11,481	11,909	14,972	50,276

Data Elements on Characteristics of the Injury and of the Injured Worker

Since 1992, BLS has collected detailed information about injuries involving days away from work. For manufacturing, the average annual number of cases in this category has averaged over 500,000. The required data elements include: the nature of injury, the causal event, the source of the injury, the part of body affected, and the occupation, age, and sex of the injured worker.

In its 1998 survey packet to employers, BLS noted that "We have designed this survey to ensure that you don't have to report more than approximately 30 [days away

from work) cases. If you find you have significantly more, please go to *If You Need Help...* at the back of this package and call the phone number listed for your State for assistance.” However, in our review of the data, we did not find any particular point—neither 20 nor 30 cases—at which an unusually large number of cases were reported; and we found many establishments which reported many more than 30. Thus we proceeded under the assumption that any biases in this regard are not serious, although we can not rule out the possibility that they are.

Access to BLS Data

We received permission to work with BLS confidential microdata under the terms of an April 16, 1998 BLS working draft document. BLS considers whether the research will advance its mission, whether it has technical merit, whether it is of interest to BLS, whether it preserves confidentiality, and whether program resources are available within BLS. BLS requires that all work on its data be performed at its facilities in order to assure confidentiality. Data sets can not be removed after they are created even if no identifiers are included. Not surprisingly, this requirement considerably increases the cost and time needed to carry out studies, at least for researchers, like ourselves, who are not based in Washington, D.C.

Construction of the Data Set Used in Analyses Matching

The BLS and OSHA data sets lack a single unique establishment identifier to facilitate matching. The key to matching is to use a number of different characteristics of the establishment, provided on both the BLS and OSHA datasets (name, address, industry, and size). Building on the conceptual work of Fellegi and Sunter (1969), Gray provides a methodology for identifying whether two reports pertain to the same establishment. What Fellegi and Sunter show is that there is an optimal decision rule “d” that can be calculated if we have some subgroup of the possible pairs for which we have identified the matches and non-matches. Gray started with an analysis of one state’s data to identify exactly which pairs of BLS and OSHA records match (M) or don’t match (U). For each characteristic we can calculate how often the true matches pass each test ($m(g)$) and how often the false matches pass the test ($u(g)$). The weight put on agreement is $w(g)=\log(m(g)/u(g))$.

These weights on each individual test, either positive or negative, are then added together to form the final “t-score” for those two records. Two cut-off points, T_m and T_u are calculated (based on the desired probabilities of Type I and Type II errors) with pairs having $w(g)>T_m$ considered matches, pairs having $w(g)<T_u$ considered non-matches, and those with $T_u<w(g)<T_m$ considered uncertain and in need of manual checking.

Empirically, a first step is to “clean” the fields to minimize the effect of common variations in spelling and ordering on the matching procedure. The example that follows deals with the address field:

For the address field, a number of different match criteria are extracted. These include route number, box number, address number, and first ‘important’ word of the address. One or more of the number fields are often missing, but ‘33 Wombat Road Route 7 Box 23’ is possible, and this inspection would have all fields present. The use of multiple criteria is important because one inspection might use ‘Box 7 Route 23’, another ‘Wombat Road’, or even just ‘Route 7,’ and the procedure should be able to give at least some weight to agreement when it occurs. Of course, the last two cases would not be matched at all, but the procedure notes that they refer to different parts of the address (and does not count that as disagreement). In selecting the ‘first’ word of the address, many common descriptive words (e.g., ‘NORTH’, ‘LOWER’) are ignored, as these are sometimes left out of the address, although the procedure is clever enough to recognize the ‘NORTH’ in ‘NORTH STREET’ as an important word and retain it.

The following Table shows the weights on the match criteria we used for this study.

Table B
Weights on Matching Criteria

Name		
Agrees on all 30 characters		+9
Agrees on first 6 characters		+7
Agrees on first 3 characters		+6
None of the above		-2
Street Address		
Agrees on all 30 characters		+10
Agrees on first 4 letters		+6
First 4 letters included somewhere		+4
None of the above		-3
Street number (if present in both)		
Same street number		+7
Differing by more than 10		-4
Box number (if present in both)		
Same P.O. box number		+6
Disagree on box number		-3
Route number (if present in both)		
Same		+4
Disagree on route number		-3
Zip Code		
Agree on 5 digit zip code		+5
Agree on 3 digit zip code		+3
Disagree on 3 digit zip code		-5
Industry code (SIC)		
Agree on 4 digit industry code		+4
Agree on 3 digit industry code		+3
Agree on 2 digit industry code		+2
Disagree on 2 digit code		-2
Employment (if both over 100)		
If within 20% of each other		+1
City		
Same first 3 letters		+4
Different		-3

The total agreement for each pair, its 'w' score, is the sum of the pair's scores on each individual characteristic. In the manufacturing study, the necessary score for calling the pair a match was +10. This was calculated to give a probability of falsely matching an OSHA inspection of one establishment with BLS injury data from another establishment of less than 0.01% and a probability of failing to match an inspection with its own injury data of less than 1%.

In principle, this procedure requires comparing every record in one data set with every record in the other one. However, it is possible to greatly reduce the comparisons needed by "blocking" the records. For example, if one believed that two inspections of the same plant would hardly ever report different zip codes, one could sort the inspections by zip code, and only compare those inspections within the same zip code "block." More than one variable can be used to define the blocks, and one can use several different blocking schemes to reduce the chance of failing to match inspections that happen to fall into different blocks.

Variables

Our analyses included a substantial number of variables. Here we review the major variables that were used. Table 1 includes the means for each of these variables

Establishment-specific explanatory variables included the following:

- a) Number of workers employed
- b) Number of hours worked
- c) Dummy variables for 2 and 4 digit standard industrial classifications (SICs)
- d) Dummy variables for year
- e) Dummy variable for state
- f) Dummy variable for union representation (available only for inspected establishments)
- g) Dummy variables for establishment size categories
- h) Dummy variables for firm size categories (available only for inspected establishments)
- i) Ratio of the establishment's lost workday injury rate to the average rate for its 4-digit SIC

In addition, an autoregressive coefficient in the error term measures the tendency for injuries to return to the mean level, the so-called "regression to the mean."

The basic set of policy-related variables included the following:

- a) Dummy variables for whether the plant had at least one programmed, complaint, or referral inspection during the year.
- b) Dummy variable for whether the plant received a penalty during a programmed, complaint, or referral inspection during the year.
- c) Dummy variable for whether the plant had an inspection but was not penalized.
- d) Dummy variables for inspection type—e.g., programmed, complaint, etc.
- e) Variables for the hours of inspection time on-site
- f) Dummy variables for whether the inspection was "partial" or "comprehensive"
- g) Variable for the number of serious violations cited
- h) Variable for the amount of penalty proposed
- i) Variable for the amount of penalty finally imposed
- j) The number of years since the last inspection
- k) Dummy variable for whether a federal OSHA or "state plan" state

Injury/Event Type and Individual Standards

One part of our study examined the relationship between the types of injuries that declined at inspected workplaces and the types of violations that were cited there. Because there are potentially thousands of different specific injury types and many hundreds of different violations, we needed to carry out some grouping of injury types and violations in order to make the analysis manageable. Of the 4 data elements on the characteristics of the injury, the one that is most relevant is the "event/exposure" codes. Table AI in the Appendix shows the full list of the codes BLS uses.

We asked the OSHA Office of Field Coordination to assist us in identifying which injury events were addressed by OSHA standards. Staff in that office reviewed

each OSHA standard at the 8-digit level and made judgments about which of the event codes in Table A1 would be addressed by the standard. The “8-digit level” of a standard refers to the broad level that identifies the topic of the standard, but not its specific provisions. For example, 1910.0132 gives the general requirements for personal protective equipment. The first part of this expression—“1910”—refers to Part 1910 of the Code of Federal Regulations. It is part of all of OSHA’s general industry standards (but not for construction or maritime standards).

We looked at the number of times that OSHA’s analyst linked a standard to a particular injury event code. The more standards linked to an injury type, the more likely we judged that injuries of that type would be affected by inspections. This measure may not be valid. Simply counting the number of different standards that pertain to an injury type may not tell us what percentage of those injuries would be prevented by better compliance with standards. This method did have face validity insofar as it accorded with some known facts about the OSHA standards. For example, OSHA has many standards about machine guarding; therefore, injuries due to getting “caught-in machinery” would rate as highly standards-related. At the other extreme, strains and sprains from overexertion are not addressed at all by existing OSHA standards (as the debate about OSHA’s proposed ergonomics standard demonstrated).

The injury event categories that we examined account for 95% of all DAW injuries reported to OSHA. The numbers of each in our sample are shown in the Table below.

Table C
The Frequency of Different Event Types in the Full Sample

	Variable <u>Name</u>	BLS Event <u>Codes</u>	
Struck by	A1	020-029	24,131
Caught in	A2	030-039	18,777
Falls from heights	A3	110-129	8,102
Eye abrasions	A4	053	4,976
Caught in-machinery	A5	031	8,022
Toxic substances	A6	31-349	12,165
Bodily reaction and exertion	B1	210-239	68,081
Struck against	B2	010-019	18,235
Falls on same level	B3	130-139	14,642

Examining the Effects of Citing Particular Standards

With several hundred 8-digit standards and many thousands of specific provisions within them, it clearly would not have been feasible to systematically examine all of them. We decided to focus on 5. One prerequisite was that the standards would have to be ones that are frequently cited. If a particular standard was cited in our sample only infrequently, we would have little chance of estimating its effects with any precision.

We also wanted standards where we thought that citations and abatement could plausibly prevent injuries. For this reason, we chose 1910.0212, which is the standard providing general requirements for machine guarding (as opposed to other machine guarding standards that are specific to particular machines, e.g., power presses). We also chose 1910.0132, which is the standard which provides general requirements for personal protective equipment (as opposed to standards for specific types of PPE—e.g., respiratory, head protection).

It is often useful to include categories that one believes will not have an effect on the dependent variable in question. If these do turn out to have an effect, it casts doubt on the validity of the underlying categorizations, the estimated effects, or both. For this reason, we included two standards that we thought would have very little effect on injuries. The first, 19100305 deals with the requirements for electrical wiring. Our reasoning was that violations of this standard were unlikely to affect injury event types other than electrocutions, a very small category. The second standard was the requirement for fire extinguishers. Here again, this seemed relevant only to the prevention of burns from fires, another very small category of injuries.

Finally, we included a fifth standard which we thought might have a moderate impact on injuries. This was 19100157, the standard addressing industrial lift trucks (forklifts). Below we see the number of times that these standards were cited by OSHA in our data set.

Table D
The Frequency of Citations for Different Standards in the Full Sample

			<u># cited</u>
A1	19100212	machine guarding, general requirements	2667
A2	19100132	personal protective equipment (PPE), general requirements	1130
A3	19100303	electrical wiring	2385
A4	19100178	industrial trucks	1017
A5	19100157	fire extinguishers	1139
A6	19100212-0219	Any machine guarding standard	5973
A7	19100132-0139	Any PPE standard	3114

There is a considerable degree of overlap among the standards cited in inspections at a given establishment. In the Table below, if the standard in the column on the left was cited, then the columns to the right tell the percentage of times that the other standards were cited in the same inspection.

Table E
Overlaps in the Citations of Different Standards in the Same Inspection

	A1	A2	A3	A4	A5	A6	A7
A1	100%	14%	46%	17%	20%	100%	31%
A2	41	100	39	14	21	52	100
A3	54	15	100	18	25	33	69
A4	56	16	52	100	32	37	71
A5	52	18	55	25	100	39	68
A6	39	43	37	14	19	100	52
A7	74	13	44	16	19	30	100

Differences Among Establishment Size Categories in Types of Injuries

In our sample, the distribution of injury types varied somewhat among size categories of establishments. Establishments with fewer than 100 employees had smaller percentages of overexertions, eye abrasions, and struck against injuries and larger percentages of “struck by” injuries. For example, those small establishments had 5.8% of all strains and overexertions, but 10.2% of “struck by” injuries. Establishments with more than 499 workers had 52% of eye abrasions and “struck against” injuries and 50% of the strains and overexertions, but 41% of falls from heights, 42% of “struck-by” injuries, and 43% of “caught in” injuries.. With the exception of eye abrasions, the injury types which comprise a larger percentage of DAW injuries at large establishments were generally the ones that we initially judged to be less closely related to standards.

Models

Our initial analysis of the impact of OSHA inspections on injuries will use regressions. The dependent variable is the percentage change in lost workday (LWD) injuries at the establishment. The explanatory variables include measures of plant characteristics (X_{it}), inspection characteristics (ENF_{it}), and an autoregressive error term (u_{it} , found to be an important determinant of injuries in Gray and Scholz [1993]).

The resulting regression equation to be estimated is:

$$\log(\text{LWD}_{it}) - \log(\text{LWD}_{it-1}) = aX_{it} + \sum_{j=0}^2 b_j * \text{ENF}_{it-j} + u_{it},$$

and $u_{it} = \rho u_{it-1} + e_{it}.$

This simple form of the equation includes only a single ENF variable, but allows for a lagged effect of inspections. In this case, the total impact of an inspection on injuries is given by the sum of four b_j components, corresponding to four different years (the current year of b_0 , and three preceding years, b_1 , b_2 , and b_3). F-tests are used to test whether the sum of the four b_j terms is different from zero. A number of plant characteristics are also included (allowing X_{it} to represent a vector of characteristics rather than a single term), to control for other factors affecting the establishment's reported lost workday injuries.

We expand the model in a number of ways. First, we include multiple ENF measures. For example, earlier research considered two versions of the inspection variable: those inspections which imposed penalties and those which didn't. When both were included in the same equation, the penalty inspections had a significant negative relationship to injuries, but the non-penalty inspections had little or no effect.

Other characteristics of inspections may be important: earlier research found some differences in the way that complaint inspections and programmed inspections are related to injuries (Scholz and Gray [1997]). This suggests the need for interactions between an inspection's characteristics and its impact on injuries.

Finally, different types of establishments may respond differently to enforcement. Earlier results suggest that smaller plants seem to be more affected by inspections than large ones. This may be related to their being less frequently inspected, so that any given inspection is more noteworthy in a small plant. In this case, interactions between ENF and X would serve to test for possible differences. A greater responsiveness of small plants to inspections would correspond to a significant negative coefficient on the term $\text{ENF} * X$, if X is a dummy variable indicating a small plant.

One issue that arises when comparing the results here with the published results of the earlier studies is the choice of estimation method. All of the results presented here are based on ordinary least squares regressions. The earlier studies (such as Scholz and Gray (1990)) allowed for autoregressive errors, recognizing the possibility that shocks to injuries in one year might increase attention to safety, generating negative autocorrelation or regression to the mean in the injury generating process. We experimented with estimating an autoregressive model with the newest data set, and found that while the autoregressive terms were estimated to be significant, the results for the inspection variables were essentially unchanged from those reported here (results available on request).

More importantly, some of the earlier analyses of data from 1979-85 and 1987-91 used a 'Chamberlain' model (Chamberlain (1982, 1984)), which allowed for the possibility that inspection targeting led to the set of plants selected for inspections to be those with poorer performance in terms of injury growth (Gray and Scholz (1993), Gray (1996)). Correcting for this effect results in a greater (negative) impact of inspections on injury growth, since these plants are predicted to have done even worse if they had not been inspected. In the earlier research, using the Chamberlain method increased the estimated impact of an inspection with penalty in the 1979-1985 period by 7%, from 15% to 22%. Using the 1987-1991 period the comparable impact also rose by 7%, from 8% to 15%.

Preliminary estimates of the Chamberlain model for the most recent period suggest a similar impact (the reduction in injuries after a penalty inspection increases in magnitude from about 1% using ordinary regression to about 7% using the Chamberlain model). Thus the comparison across time periods gives a similar conclusion to the ordinary regression results presented here, with a substantial reduction in the impact of an inspection with penalty between Period 1 and Period 3. We concentrate on ordinary regression results in this paper primarily because the Chamberlain estimation method requires complete injury data, and hence can only be calculated for a small and unrepresentative minority of the plants in the 1992-1998 period (860 plants, nearly all of them in the larger size categories, with more than 250 employees).

Results

Comparing Inspection Impacts Across Three Periods, 1979-1998

Table 1 presents the means of the variables in the three data sets. There is a decline in injuries over time (negative DINJ) within each of the three data sets. However, this does not mean that rates declined continuously from Period 1 to Period 3. Each period happens to begin when rates were fairly high and end when they were lower. The establishment size distribution differs somewhat between the three data sets, based on changes in the BLS Survey coverage and the number of years of injury data required for inclusion. The period 2 data set contains more small plants, since it only required two consecutive years of injury data; the latest data set contains a higher proportion of large plants, due to the steady shrinkage in the BLS Survey sample size.

Table 1 also reveals some substantial changes in OSHA inspection activity across the three data sets. In the earliest data set there were relatively high rates of inspections (INSP), especially programmed inspections (IPRG). These inspections commonly failed to impose penalties; only about one-third of all years with inspections had any inspections that imposed penalties (IPEN), but in the later two periods this ratio was reversed. This pattern can be explained by the existence of "records-check" inspections during the early 1980s; these inspections began with a check of the plant's injury rate records and stopped there if the plant's injury rate was below the average rate for manufacturing (Siskind (1993)). This led to a large set of programmed inspections that did not impose a penalty (and did not perform a 'real' inspection of the workplace).

There was also some variation in the composition of inspections across the periods. Because of the prevalence of programmed inspections (IPRG) in the first period, they greatly outnumbered complaint (ICMP) inspections (.19 to .06). In the later periods the probability of a complaint inspection rose slightly (to .07), while the probability of a programmed inspection fell dramatically (to .03). There was also an increase in the fraction of complaint inspections which imposed penalties (ICMPP) over time, though not as dramatic as the increase noted above for programmed inspections (IPRGP).

Table 2 shows the basic regressions of injury changes on inspections and inspections with penalty. The first column presents results from the original Scholz and Gray data set from 1979-85. The second column presents results from the 1987-1991 data set and the third column presents results from the 1992-1998 data set. As expected, growth in employment and hours worked are each expected to increase the number of injuries. Perhaps due to the 'random' nature of workplace accidents, the models only explain about 10% of the variance in injury changes across plants in each period. As found in the Scholz and Gray analysis, inspections with penalties have a larger impact than other inspections (comparing IPEN with INSP). The main result in Table 2 is that both IPEN and INSP coefficients became smaller in each succeeding period. Adding up the cumulative IPEN effect in each period, it declines from 15.7% to 9.4%, then to 1.4%, with the last period's impact not statistically significant. We also combined data from all 3 periods in order to formally compare the IPEN coefficients across periods. The results

(not shown) confirm that the Period 3 results are significantly different from those in Period 1.

In Table 3 we see the impact of combining the four years of OSHA inspections into a single variable. Since IPENX gives the average impact per year (over four years) the cumulative impact falls from 19.2% to 12.0% to 1.2% across the three periods. Comparable regressions for each period including both IPENX and inspections with no penalty (NOPENX) always found insignificant coefficients on NOPEN (results available).

The initial regression results presented in Tables 2 and 3 provide evidence of a substantial decline in the measured impact of OSHA inspections on manufacturing industries. We now consider different categories of inspections and establishments to see how widespread the decline is. Looking at inspection type, Scholz and Gray (1997) found that both complaint and programmed inspections affected injuries, but that complaint inspections were less dependent on penalties for their impact. Table 4 shows the impact of complaint and programmed inspections on injuries in each of the periods, confirming that programmed inspections are more dependent on penalties for their impact. The impact of complaint inspections with penalties declines more in the 1980s, while the impact of programmed inspections with penalties declines more in the 1990s. However, these differences between the inspection types were not statistically significant.

Next we allow the impact of OSHA inspections to differ depending on characteristics of the establishment. Table 5 examines the effects of inspections with penalties in 4 different establishment employment size categories: small, under 100; medium, 100-249; big, 250-499; and very big, over 500. We find much weaker preventive effects of inspections among the largest establishments than in smaller establishments (similar to results reported in Gray and Scholz (1991)). More importantly we have declines in the estimated impact across the periods for nearly all cases, and always smaller impacts in Period 3 than in Period 1. The timing of the decline varies across size classes, but the decline is statistically significant for all but the medium plants.

Next we allowed for different OSHA impacts across different industries, shown in Table 6. Examining the model for all 3 periods together, we added interaction terms between IPENX and two-digit SIC manufacturing industry dummies. Each interaction term provides an estimate of the effect at an establishment in that industry of having at least 1 inspection with penalty over a four year period. There are a few significant industry coefficients, but there is no industry where the effect of inspections with penalties is significant in more than one period. Not surprisingly, there is no significant correlation across industries in their coefficients for different periods.

Table 7 tests whether these industry-period coefficients are correlated with three factors that might affect OSHA's impact: the average lost workday injury rate in the industry (bigger effects if there are more injuries per worker to prevent), the average inspection rate in the industry (smaller effects when firms are expecting OSHA inspections), and the average investment rate in the industry (new plant and equipment is safer than what it replaces). These correlations are relatively small, and only two

approach significance. For industry coefficients based on all workplaces, higher investment rates were weakly linked to smaller inspection impacts. Looking at workplaces with fewer than 250 workers (where the effects were larger in the last period), the link with investment rates disappears but a weak negative relationship appears with the industry inspection rate.

Finally, we consider the possibility that OSHA inspections have different impacts on different types of injuries. Table 8 shows the results for our basic model, separated into cases with days away from work (DAW) and cases with only restricted work activity (RWA). One clear finding is that, even in Period 1, all of the impact of inspections with penalties was on DAW injuries. There was no impact on RWA injuries. In Period 2, there is even some indication that inspections were linked to increases in RWA injuries, but this disappears in Period 3.

Detailed Findings on Inspection and Workplace Characteristics, 1992-98

Impacts of Inspections and Inspections with Penalties

The first column of Table II-2 shows the effect of inspections with penalties (IPEN) in different years on the percentage change in the total number of lost workday (LWD) injuries for the entire sample of establishments. For example, for an establishment for which we have data on the change in injuries from 1994 to 1995, IPEN would give the effect of an inspection in 1995. IPENL1 would give the effect of an inspection in 1994; IPENL2, an inspection in 1993, and IPENL3, an inspection in 1992. Penalty inspections in L1 had a significant and negative effect on injuries with days away from work (DAW). An "F" test (not shown) allows us to reject the hypothesis that the four IPEN coefficients add up to zero. For injuries with restricted work activity only (RWA), penalty inspections in L2 had a positive and significant effect but penalty inspections in L3 had an offsetting significant and negative effect. The only significant effect on the whole LWD category comes from inspections in L3.

To provide a simpler way of presenting results, we created a variable (IPENX) which takes the value of 1 if there was an inspection with a penalty in any of these 4 years. For the full sample, the IPENX variable had a value of 1 in just over 26% of the observations. Its coefficient is usually close to the average effect across the 4 years. The IPENX coefficient should be interpreted as having a cumulative effect; e.g. a coefficient of -0.020 implies that over the 4 years, the rate is reduced a total of 8%. The third set of regressions in Table II-2 shows the estimated coefficients for IPENX separately for State and Federal inspections. For neither the entire sample, nor the Federal or State Plan states is the effect of IPENX on the total LWD category statistically significant. However, the effect is negative and significant for DAW injuries for both Federal states and the entire sample. An "F" test did not, however, reject the hypothesis that the federal and state IPENX coefficients were the same.

The effects of inspections with penalties on RWA injuries are positive for all 3 samples; although these coefficients are not statistically significant, the positive effects on RWA injuries clearly weaken the overall preventive effect on the larger category of LWD injuries

The employment and hours worked variables shown in Table II-2 both have the expected positive coefficients. For example, in the first regression, a 10% increase in employment, holding the hours worked constant, increased the number of LWD injuries by 4.1%; and a 10% increase in hours worked, holding employment constant, increased LWD injuries by 2.3%. We also included industry dummy variables (at the 2 digit SIC level) and year dummy variables in all regressions in order to capture injury changes that were related to developments in a particular industry or a particular year. In some models, we also tested state dummy variables in order to capture possible differences across states, particularly those arising from change in state workers' compensation laws. Including state dummy variables slightly (i.e., by 5% to 10%) increased the size and significance of the IPENX coefficients. We also looked at the effects of introducing industry controls at the 4-digit SIC level; again the incremental effects on the inspection coefficients were quite small and are not shown here.

Impacts on Establishment of Different Sizes

Panel A of Table II-3 show the impacts of inspections with penalties on LWD, DAW, and RWA injuries in establishments in 4 size categories: small, 1-99 workers; medium, 100-249; big, 250-499; and very big, 500 and over. Among all small establishments, the effects are negative and significant at the 0.10 level for LWD injuries and at the 0.05 level for DAW injuries. For DAW injuries, the effects of inspections with penalties decrease steadily with increasing establishment employment. Because of these findings, we focus our attention on workplaces with fewer than 250 workers.

Panel B of Table II-3 presents only the coefficients (and not the 't' statistics) from a regression that estimated IPENX*size interaction coefficients separately for Federal and State Plan states. These findings show that the LWD impact at "small" establishment came almost solely from the State Plan States. However, for DAW injuries, the negative coefficient was actually larger in Federal states (and had a 'p' value of 0.11) than in State Plan states. In Federal states, however, the preventive effect of penalty inspections on DAW injuries in "small" establishments was largely offset by the opposite impact on RWA injuries.

The three control dummy variables for establishment size show clearly that, during this period, the LWD and DAW rates at small establishments were increasing, and their RWA rates were decreasing, relative to establishments with over 500 workers.

Impacts of Different Types of Inspections with Penalties

Table II-4 reports the results for 3 different inspection types: programmed, complaint, and referral. The top panel shows the results for all establishments, while the bottom panel shows the results for establishments with fewer than 250 workers. For the full sample of establishments, we find statistically significant effects for complaint inspections with penalties in both State Plan and Federal states. For establishments with fewer than 250 workers, this effect is still statistically significant only in State Plan states. In this size group, the largest impact in Federal states is found for referral inspections, although the effect for this relatively small group of inspections is far from statistical significance.

A further breakdown of findings for inspection types appears in Table II-5. Looking at establishments with fewer than 250 workers, we incorporate the distinction between safety and health inspections, complaint and programmed inspections, and inspections with and without a penalty to create 8 categories. (Because of the numerous subcategories, we did not try to include the smaller category of referral inspections in this analysis.)

Table II-5 reveals the surprising finding that health inspections with penalties had the greatest impact on the number of injuries. For reducing LWD injuries, health programmed with penalty had the biggest impact (statistically significant at 0.10), followed by health complaint inspections with penalties. For reducing DAW injuries, the biggest impact was from health complaint inspections with penalties (significant at 0.01),

followed by health programmed inspections with penalties. Health inspections without penalties also had the largest impact on *increasing* the number of RWA injuries; the figure for health programmed inspections without penalties was statistically significant at 0.10.

Evidence for any preventive impacts was weaker for programmed safety inspections with penalties than for safety complaint inspections with penalties, although neither came very close to statistical significance. In regressions not shown, we also looked at the effects of all of these inspection types in Federal and State Plan states separately. There we find that the preventive impact of programmed health inspections occurs predominately in Federal states, while the preventive impact of complaint health inspections occurs predominately in State Plan states.

In thinking about the overall role that different inspection types play, we need to know not only the impact of inspections with penalties, but also the percentage of inspections which levy penalties. Table II-6 shows, by size groups in Federal states and State Plan states, the percentage of inspections in each of these inspection categories which levied penalties. In general, federal OSHA inspections are more likely to levy penalties. The difference is especially pronounced for health inspections in Small and Medium establishments. In Federal states, the probability of penalties in health inspections declines fairly sharply with increasing establishment size. In State Plan states, this is true for health complaint inspections but not programmed health inspections. Thus for health inspections, not only do penalty inspections usually have stronger effects on injuries at smaller than at larger establishments, but we also find that the inspections are usually more likely to involve penalties at smaller establishments.

Impacts in Different Industries

We also examined whether inspections were substantially more or less effective in particular industries. In Table II-7, we show the interactions of IPENX with the 2-digit manufacturing standard industrial classifications for DAW injuries in establishments with fewer than 250 workers in all states. When we ran a regression that calculated separate coefficients for Federal and State Plan states, we found almost no agreement in the industry effects in the two samples. Only 8 of the 19 SIC*IPEN coefficients had the same sign and the correlation between the two sets of coefficients was less than +0.07. For example, the coefficient for SIC 34 (fabricated metal), which is +0.053 with a 't' statistic of 1.70 in the national sample was -0.020 with a 't' statistic of 0.43 in the Federal states and was +0.086 with a coefficient of 2.28 in the State Plan states. It seems plausible that, if there were strong industry-specific effects of inspections with penalties, we should find more agreement across the two groups of states than we find here.

The Role of Unions

An investigation of the role of unions required a somewhat different estimation method because we know the unionization status of an establishment only for those that have been inspected. (That variable comes from the OSHA IMIS inspection file, not

from the BLS Survey of Injuries and Illnesses.) If an establishment had been described as unionized in any inspection, we labeled it a unionized workplace (ANYUNION=1). Unionized workplaces were 9.7% of Small establishments; 18.4% of Medium; 24.0% of Big; and 32.3% of Very Big. They comprised 21.8% of the entire sample. We interacted this variable with IPENX to identify whether the presence of a union enhanced or diminished the impact of penalty inspections on injuries. For workplaces which had no inspections in our data base, we had no information on the union status. These observations with unknown union status were coded as UNIONUNK=1.

Table II-8 shows that IPENX was negative in all injury categories in both State Plan and Federal States. In the latter, IPENX is significant for LWD injuries and, surprisingly, RWA injuries. This coefficient is the only one in our study that shows a negative and significant effect of penalty inspections on RWA injuries. The presence of a union was associated, in all size categories and both regions, with a greater decline in injuries for all 3 injury categories, although the effects were not statistically significant. The union*IPENX interaction coefficients are almost all positive, indicating that penalty inspections at unionized workplaces have less impact than at non-unionized workplaces. However, these effects are significant only for RWA injuries in Federal states. For these unionized plants, we can conclude that penalty inspections lead to increases in reported RWA injuries. However, F tests indicate that for RWA, and the other injury categories, we can't reject the hypothesis that the total effect of penalty inspections at unionized establishments is zero.

The UNIONUNK coefficient shows that, compared to establishments which were inspected but not penalized, injuries declined at establishments that were never inspected. This result appears attributable solely to differences in RWA injuries.

We repeated the analysis above using, first, complaint inspections with penalties, and then programmed inspections with penalties. The results (not shown) were similar.

Impacts in Different States

Finally, we examined whether we could detect differences in the impact of penalty inspections among some of the State Plan states. These states have some flexibility in how they operate their enforcement programs. Table II-9 shows the effects of IPENX, for establishments with fewer than 250 workers, on LWD, DAW, and RWA injuries in the 7 State Plan states which had the largest number of observations. The regression also includes the estimate for all other states combined. Except for RWA injuries in Kentucky, none of the state coefficients are statistically significant; and we can not reject the hypothesis that all are equal to zero. However, in 4 states the magnitude of the DAW coefficients is larger than we found in Federal OSHA states. Statistical significance is, of course, harder to achieve with smaller sample sizes; the state subsamples here ranged from a high of 4,278 in California to a low of 1,479 in Washington.

Findings on the Effects of Inspections and Particular Citations on Different Injury Types

Table III-1 reports the impact of inspections with penalties in the year of the injury change measurement or any of the 3 preceding years (IPENX) on days away from work (DAW) injuries for different injury events. We limited the analysis to establishments with fewer than 250 workers because of our prior finding that preventive effects were rare among larger establishments. We described above how we derived our expectations about which types of injury events would be more affected by the requirements of OSHA standards. Here we see that, contrary to those expectations, the largest effect of penalty inspections occurs among overexertion injuries and the second largest effect among “struck against” injuries, both of which were in the category that we believed would be less affected. These coefficients were statistically significant at the 0.05 level.

Smaller in magnitude and significant at the 0.10 level were the coefficients for eye abrasions and toxic substance injuries. None of the coefficients for the other injury events even had a ‘t’ statistic greater than 1. We included the injury type “caught in or between machinery,” a subcategory of the “caught-in” category, in order to test more precisely the effect of inspections on injuries which we thought would often be preventable by enforcement of OSHA’s machine guarding standards. Instead, this event type showed the least evidence of inspection impact. Neither injuries due to falls from heights nor injuries due to falls on the same level showed any evidence of inspection impacts.

In interpreting these findings, it is useful to recall the relative magnitudes of the different injury event categories. The bodily reaction and exertion category comprised almost 46% of the over 500,000 DAW injuries in manufacturing; the struck by category, 14%; the struck against category, the “caught in or compressed by equipment or objects,” and the falls on same level categories all each involved 8%; exposures to harmful substances or environments, 5%; caught in machinery, 4%; falls to lower levels, 3%; and eye abrasions, 2%. The overall effects of inspections on DAW injuries are dominated by the effect on “bodily reactions and exertions,” a category for which OSHA really has no applicable standards.

We also looked at the effects, not of inspections, but of citing particular OSHA standards on changes in particular injury event categories. We described above how we chose the 5 standards shown here. For this test we limit the sample to establishments in federal states because several State Plan states, including California, Washington, and Michigan, use a totally different set of coding for standards than federal OSHA does. Several other State Plan states have additional codes that Federal OSHA does not have. Thus, to keep the meaning of the codes clear, we limited the sample to Federal states.

Table III-2 shows the results. As we explained earlier, the standards must be entered simultaneously because there is considerable overlap; i.e., the different standards are frequently cited in the same inspection. Thus to tease out the effects of each, we have to consider all of them together in the same model. (The results we show here do not

include the toxic substances event type.) In the analysis of establishments with fewer than 250 employees, with five standards and eight event types, we found 5 coefficients that were negative and significant. Four of the five were found in analyses of the general personal protective equipment standard. When that standard was cited, both eye injuries and caught-in injuries declined by over 6% a year for 4 years, an amount that was statistically significant at the 0.05 level. In addition, both the “caught in machinery” subcategory and the bodily reaction and overexertion category showed preventive effects at the 0.10 level.

The only other statistically significant effects were on the number of falls from heights. Citations of the general machine guarding standard were associated with a decrease in these events, while citations of the general personal protective equipment were associated with increases. In both cases, it seems difficult to see how these standards would have any direct effect on this injury event category.

In terms of the original assumptions about the relation of the particular standards to injuries, the assumption about the preventive effects of the PPE standard appears correct, but the machine guarding standard clearly had less impact than anticipated. Those standards which we thought would have no effect (electrical wiring and fire extinguishers) indeed had no effect. Nor did the forklift standard, which we expected to have an impact somewhere between the other two sets.

Among establishments with more than 249 workers, we found only 2 statistically significant results, both for the PPE standard. It still has a preventive effect on caught-in injuries and a perverse effect on falls from heights. Among these larger workplaces, the PPE standard’s preventive effect on eye injuries, which had been quite clear in the smaller group, essentially disappears.

Table 1***Database Description***

	<u>1979-1985</u>	<u>1987-1991</u>	<u>1992-1998</u>
Number of Observations	27,368	32,765	25,603
Number of Plants	6,842	14,386	8,161
Plants in BLS Dataset for all years	6,842	3,118	860
Required Continuous Years of BLS Data	7 years	2 years	3 years

Variable Means by Period

	<u>1979-1985</u>	<u>1987-1991</u>	<u>1992-1998</u>
Continuous Variables			
DINJ log change in injuries	-0.046	-0.029	-0.043
DHOUR log change in hours	-0.024	-0.032	-0.011
DNUM log change in employment	-0.046	-0.029	-0.043
DDAW log change in DAW injuries	-0.075	-0.029	-0.082
DRWA log change in RWA injuries	0.036	0.059	0.040
Employment Size			
SMALL employment <100	0.196	0.325	0.221
MEDIUM employment 100-249	0.332	0.300	0.222
BIG employment 250-499	0.239	0.181	0.240
VERY BIG employment 500+	0.232	0.194	0.316
OSHA Inspection Dummy Variables (years t through t-3)			
INSP any inspection in year	0.244	0.119	0.082
IPEN any penalty inspection	0.080	0.082	0.052
IPRG programmed inspection	0.193	0.045	0.026
ICMP complaint inspection	0.061	0.073	0.069
IPRGP programmed with penalty	0.063	0.035	0.034
ICMPP complaint with penalty	0.018	0.046	0.035
OSHA Combined Inspections – (Value of Any of the 4 lagged dummy variables equal 1)			
INSPX INSP-INSP3	0.625	0.383	0.258
IPENX IPEN-IPEN3	0.283	0.245	0.194
IPRGX IPRG-IPRGL3	0.522	0.228	0.112
ICMPX ICMP-ICMPL3	0.229	0.207	0.171
IPRGPX IPRGP-IPRGPL3	0.221	0.141	0.093
ICMPPX ICMPP-ICMPP3	0.086	0.124	0.113

Table 2

**Impact of OSHA Inspections on Injuries
(current and last 3 years)**

PERIOD	1979-85	1987-91	1992-98	1979-85	1987-91	1992-98
INTERCEP	-0.097 (-6.91)	0.088 (6.63)	-0.044 (-2.92)	-0.094 (-6.53)	0.087 (6.46)	-0.045 (-2.97)
IPEN	-0.058 (-4.09)	0.004 (0.33)	-0.002 (-0.13)			
IPENL1	-0.046 (-3.22)	-0.036 (-2.76)	0.010 (0.58)			
IPENL2	-0.048 (-3.46)	-0.016 (-1.18)	-0.016 (-0.97)			
IPENL3	-0.005 (-0.42)	-0.046 (-3.37)	-0.006 (-0.38)			
INSP				-0.019 (-2.13)	0.014 (1.28)	0.01 (0.67)
INSPL1				-0.025 (-2.76)	-0.023 (-2.19)	0.006 (0.43)
INSPL2				-0.024 (-2.63)	0.003 (0.28)	-0.012 (-0.84)
INSPL3				(-0.005) -0.52	(-0.025) -2.61	(-0.008) -0.55
DEMP	0.451 (16.36)	0.391 (18.82)	0.447 (20.25)	0.452 (16.39)	0.391 (18.81)	0.447 (20.25)
DHOUR	0.362 (16.43)	0.291 (16.48)	0.172 (9.52)	0.38 (16.37)	0.291 (16.48)	0.172 (9.52)
R ²	0.116	0.116	0.088	0.115	0.116	0.088

Note: "t" statistics in parentheses; regressions include year and SIC2 dummies.

Table 3

**Impact of OSHA Inspections on Injuries
(any in current or last 3 years)**

PERIOD	<u>1979-85</u>	<u>1987-91</u>	<u>1992-98</u>	<u>1979-85</u>	<u>1987-91</u>	<u>1992-98</u>
INTERCEP	-0.096 (-6.86)	0.089 (6.68)	-0.045 (-2.95)	-0.096 (-6.49)	0.087 (6.38)	-0.047 (-3.07)
IPENX	-0.048 (-5.47)	-0.030 (-3.63)	-0.003 (-0.27)			
INSPX				-0.026 (-3.15)	-0.013 (-1.72)	0.003 (0.37)
DEMP	0.451 (16.36)	0.392 (18.85)	0.447 (20.26)	0.452 (16.39)	0.392 (18.84)	0.447 (20.26)
DHOUR	0.381 (16.41)	0.291 (16.47)	0.172 (9.52)	0.381 (16.38)	0.291 (16.47)	0.172 (9.52)
R ²	0.116	0.116	0.088	0.115	0.115	0.088

Note: 't' statistics in parentheses; regressions include year and SIC2 dummies.

Table 4

Impact of OSHA Inspections by Inspection Type

PERIOD	1979-85	1987-91	1992-98	1979-85	1987-91	1992-98
INTERCEP	-0.096 (-6.88)	0.089 (6.71)	-0.044 (-2.90)	-0.096 (-6.56)	0.087 (6.38)	-0.046 (-3.01)
IPRGPX	-0.043 (-4.55)	-0.035 (-3.38)	-0.005 (-0.36)			
ICMPPX	-0.043 (-3.15)	-0.019 (-1.73)	-0.005 (-0.43)			
IPRGX				-0.016 (-2.00)	-0.010 (-1.18)	0.004 (0.28)
ICMPX				-0.033 (-3.55)	-0.012 (-1.36)	-0.001 (0.10)
DEMP	0.451 (16.36)	0.392 (18.86)	0.447 (20.26)	0.451 (16.35)	0.392 (18.84)	0.447 (20.26)
DHOUR	0.381 (16.40)	0.291 (16.47)	0.172 (9.53)	0.381 (16.38)	0.291 (16.47)	0.172 (9.52)
R ²	0.116	0.116	0.088	0.115	0.115	0.088

Note: 't' statistics in parentheses; regressions include year and SIC2 dummies.

Table 5
Impact of OSHA Inspections by Employment Size

	<u>SMALL</u> <u><100</u>	<u>MEDIUM</u> <u>100-249</u>	<u>BIG</u> <u>250-499</u>	<u>VERY BIG</u> <u>500+</u>
INTERCEPT	-0.045 (-1.77)	-0.117 (-5.88)	-0.105 (-5.19)	-0.117 (-6.19)
IPENX 1979-85	-0.063 (-2.78)	-0.037 (-2.39)	-0.058 (-3.46)	-0.034 (-2.23)
IPENX 1987-91	-0.033 (-1.87)	-0.021 (-1.36)	-0.057 (-3.16)	-0.020 (-1.30)
IPENX 1992-98	0.006 (0.22)	-0.029 (-1.24)	0.003 (0.16)	0.010 (0.71)
DEMP	0.361 (14.21)	0.469 (17.35)	0.466 (15.30)	0.449 (18.18)
DHOUR	0.174 (8.64)	0.319 (14.08)	0.324 (12.59)	0.348 (15.94)
R ²	.067	.111	.120	.150
N	21,261	24,424	18,570	20,738

Note: 't' statistics in parentheses; regressions include year and SIC2 dummies.
 Regressions for all 3 periods, separately by employment size category.

Table 6
Impact of OSHA Inspections by Industry

PERIOD	<u>1979-85</u>	<u>1987-91</u>	<u>1992-98</u>
SIC20PENX	-0.050 (-2.18)	0.025 (1.09)	-0.021 (-0.80)
SIC22PENX	-0.073 (-1.52)	-0.006 (-0.13)	0.026 (0.38)
SIC23PENX	-0.080 (-1.10)	-0.078 (-1.35)	-0.050 (-0.93)
SIC24PENX	-0.012 (-0.41)	-0.101 (-3.88)	-0.008 (-0.21)
SIC25PENX	-0.058 (-1.44)	-0.016 (-0.41)	0.027 (0.56)
SIC26PENX	0.026 (0.77)	-0.007 (-0.18)	0.019 (0.44)
SIC27PENX	-0.099 (-1.78)	-0.045 (-0.93)	-0.084 (-1.69)
SIC28PENX	-0.014 (-0.38)	0.008 (0.16)	-0.047 (-0.89)
SIC29PENX	-0.073 (-1.06)	-0.033 (-0.41)	-0.104 (-1.01)
SIC30PENX	-0.058 (-1.34)	-0.061 (-1.83)	0.010 (0.26)
SIC31PENX	-0.097 (-1.68)	-0.079 (-1.20)	-0.059 (-0.78)
SIC32PENX	-0.094 (-2.92)	0.004 (0.14)	0.059 (1.22)
SIC33PENX	-0.105 (-3.98)	-0.031 (-1.20)	-0.015 (-0.45)
SIC34PENX	-0.030 (-1.44)	-0.041 (-2.10)	-0.002 (-0.05)
SIC35PENX	-0.071 (-3.05)	-0.040 (-1.64)	-0.003 (-0.09)
SIC36PENX	-0.064 (-1.88)	-0.066 (-1.91)	0.044 (1.15)
SIC37PENX	0.022 (0.63)	-0.038 (-1.21)	0.044 (1.23)
SIC38PENX	0.023 (0.29)	0.073 (1.04)	0.026 (0.45)
SIC39PENX	-0.012 (-0.28)	0.005 (0.91)	-0.037 (-0.80)

Note: 't' statistics in parentheses; coefficients from one regression combining all 3 periods. SIC 21 contains few establishments, so it's combined with SIC 20.

Table 7

Correlations of Industry-Specific Inspection Effects with Other Variables

	Industry Investment <u>Rate</u>	Industry Lost Workday <u>Injury Rate</u>	Industry Inspection <u>Rate</u>
Inspection Impact by Industry (all establishments)	.22 (.11)	.05 (.71)	-.05 (.73)
Inspection Impact by Industry (employment<250)	-.05 (.71)	.02 (.89)	-.21 (.12)

Notes:

'p' values in parentheses.

Inspection impact by industry measured by coefficients in Table 6

(and similar estimates for the subsample of establishments with employment<250).

The sample included 19 industries in 3 time periods (N=57).

Table 8

**Impact of OSHA Inspections on Injury Types:
Days Away from Work (DAW) vs. Restricted Work Activity (RWA)**

	<u>DAW Rate</u>	<u>RWA Rate</u>
INTERCEPT	-0.120 (-11.08)	0.069 (6.35)
IPENX 1979-85	-0.050 (-5.62)	-0.003 (0.29)
IPENX 1987-91	-0.038 (-4.50)	0.017 (2.01)
IPENX 1992-98	-0.014 (-1.33)	0.004 (0.35)
DEMP	0.413 (29.98)	0.161 (11.60)
DHOUR	0.233 (20.28)	0.107 (9.26)
R ²	.086	.016
N	84,993	84,993

Notes: 't' statistics in parentheses; regressions include year and SIC2 dummies.
Regression includes all 3 periods of data.

Table 9
Declines in Number of DAW Injuries for Specific Injury Types, 1992-98

	<u>All Injuries</u>	B1 <u>Bodily Reaction</u>	B2 <u>Falls Same-level</u>	B3 <u>Struck Against</u>	<u>Sum of B</u>	
1992	352.1	163.8	25.4	27.3	216.5	
1998	204.9	92.8	17.0	15.5	125.3	
Decrease (%)	42%	43%	33%	43%	42%	
	<u>A1 Caught In</u>	A2 <u>Falls Lower-level</u>	A3 <u>Struck By</u>	A4 <u>Eye abrasions</u>	A68 <u>Harmful exposures</u>	<u>Sum of A</u>
1992	27.5	11.6	47.0	8.8	18.1	113.0
1998	18.6	6.9	29.5	4.6	10.0	69.6
Decrease (%)	32%	41%	37%	48%	45%	38%

Note: Event type B injuries were identified by OSHA staff as less likely to have injuries related to OSHA standards. The case was stronger for category A. Combined, these 8 categories included 95% of all days away from work injuries in 1998.

Table II-2

The Effects of Inspections with Penalties on the Percentage Change in Injuries

<u>ALL STATES</u>	<u>LWD</u>	<u>DAW</u>	<u>RWA</u>	<u>LWD</u>	<u>DAW</u>	<u>RWA</u>	<u>LWD</u>	<u>DAW</u>	<u>RWA</u>
intercept	-0.044 (4.03)	-0.109 (9.58)	0.092 (6.77)	-0.044 (4.04)	-0.109 (9.56)	0.092 (6.73)	-0.044 (4.00)	-0.108 (9.54)	0.092 (6.74)
IPEN	0.004 (0.35)	0.012 (1.03)	0.019 (1.32)						
IPENL1	-0.011 (0.98)	*-0.022 (1.92)	-0.002 (0.11)						
IPENL2	0.005 (0.47)	-0.017 (1.47)	***0.037 (2.73)						
IPENL3	*-0.02 (1.82)	-0.015 (1.35)	** -0.032 (2.35)						
IPENX				-0.006 (0.83)	*-0.014 (1.93)	0.009 (1.09)			
IPENX--State							-0.005 (0.55)	-0.010 (1.06)	0.011 (0.99)
IPENX-Fed							-0.007 (0.72)	*-0.019 (1.91)	0.008 (0.64)
Year94	0.360 (4.06)	0.038 (4.12)	0.008 (0.73)						
Year95	-0.021 (2.22)	-0.023 (2.39)	-0.030 (2.65)						
Year96	-0.031 (3.12)	-0.013 (1.25)	-0.077 (6.34)						
Year97	0.019 (1.75)	0.023 (2.07)	-0.039 (2.93)						
Year98	-0.006 (0.51)	0.040 (3.31)	-0.079 (5.41)						
DLEMP	0.413 (24.50)	0.376 (21.52)	0.231 (11.01)						
DLHRS	0.230 (16.35)	0.172 (11.79)	0.162 (9.23)						
N	50276	50276	50276	50276 #	50276	50276	50276	50276	50276
RMSE	0.642	0.665	0.799	0.642	0.665	0.800	0.642	0.665	0.800
RSQUARE	0.093	0.065	0.027	0.093	0.064	0.027	0.092	0.064	0.026

NOTES: All regressions also include dummy variables for industry (2 digit SIC). Year and employment and hours variables were included in all regressions; coefficients did not change and they are shown only for first regression.

't' statistics in parentheses; ***statistically significant at .01; ** at .05; * at .10, all 2-tails

Table II-3

The Effects of Inspections with Penalties in Manufacturing, by Establishment Size

a)	LWD	DAW	RWA
IPENX*SMALL INTERACTION (IPENX1)	*-0.026 (1.69)	** -0.035 (2.20)	0.008 (0.42)
IPENX*MEDIUM INTERACTION (IPENX2)	-0.007 (0.51)	-0.016 (1.07)	0.01 (0.57)
IPENX*SIZE<BIG INTERACTION (IPENX3)	-0.007 (0.05)	-0.001 (0.02)	-0.004 (0.23)
IPENX*VERY BIG INTERACTION (IPENX4)	0.013 (1.10)	0.003 (0.26)	0.012 (0.83)
SMALL (<100)	***0.03 (3.23)	***0.065 (6.73)	** -0.028 (2.41)
MEDIUM (100-249)	0.012 (1.30)	***0.030 (3.08)	-0.006 (0.50)
BIG (250-499)	*0.016 (1.72)	*0.017 (1.80)	*0.020 (1.76)
N	50,276	50,276	50,276
RMSE	0.641	0.665	0.799
RSQUARE	0.092	0.065	0.027
b)			
State IPENX1	** -0.04	* -0.033	-0.012
State IPENX2	0.009	-0.009	0.028
State IPENX3	-0.006	0.001	-0.005
State IPENX4	0.013	0.007	0.019
Federal IPENX1	-0.005	-0.039	0.039
Federal IPENX2	-0.029	-0.025	-0.014
Federal IPENX3	-0.009	-0.002	-0.003
Federal IPENX4	0.013	-0.001	0.006

Notes: 't' statistics in parentheses. Panel "b" presents only the coefficients for a regress: interaction terms separately for state and federal inspections.

All regressions include controls for year, 2-digit SIC, and changes in employment and ho

Table II-4

The Effect of Inspections with Penalties, by Inspection Type, Establishment Size, and Region

	LWD Injuries (1)	DAW Injuries (2)	RWA Injuries (3)
All Establishments N=50,276			
Programmed inspection with penalty--State	0.003 (0.23)	0.007 (0.64)	-0.003 (0.20)
Complaint inspection with penalty--State	-0.012 (0.93)	*-0.023 (1.77)	0.013 (0.85)
Referral inspection with penalty--State	-0.007 (0.24)	-0.009 (0.33)	0.029 (0.82)
Programmed inspection with penalty--Fed	-0.006 (0.43)	0.003 (0.23)	-0.011 (0.62)
Complaint inspection with penalty-Fed	-0.007 (0.52)	** -0.029 (2.22)	0.003 (0.20)
Referral inspection with penalty--Fed	-0.005 (0.24)	-0.003 (0.13)	0.032 (1.11)
All Establishments <250 N=23,319			
	(4)	(5)	(6)
Programmed inspection with penalty--State	-0.002 (0.14)	0.007 (0.44)	-0.007 (0.41)
Complaint inspection with penalty--State	-0.033 (1.43)	** -0.059 (2.57)	0.021 (.89)
Referral inspection with penalty--State	-0.017 (0.38)	-0.035 (0.79)	0.02 (0.43)
Programmed inspection with penalty--Fed	-.014 (0.66)	-0.012 (0.57)	-0.008 (0.38)
Complaint inspection with penalty-Fed	-0.012 (0.46)	-0.036 (1.42)	0.021 (0.79)
Referral inspection with penalty--Fed	-0.046 (0.96)	-0.053 (1.12)	-0.001 (0.02)

Notes: 't' statistics in parentheses.

** Significant at the .05 level; * significant at the .10 level, both 2-tailed

All regressions include controls for year, 2-digit SIC and changes in employment and hours

**The Effects of Inspections with Penalties by Detailed Inspection Type,
Establishments<250**

<u>Inspection Type and Outcome</u>	LWD	DAW	RWA
Health Programmed with Penalty	*-0.047 (1.65)	-0.041 (1.47)	-0.016 (0.55)
Health Programmed without Penalty	0.045 (1.05)	-0.007 (0.16)	*0.076 (1.75)
Health Complaint with Penalty	-0.028 (1.15)	***-.068 (2.86)	0.034 (1.36)
Health Complaint without Penalty	0.014 (0.47)	0.004 (0.13)	0.042 (1.41)
Safety Programmed with Penalty	-0.001 (0.00)	0.004 (0.31)	-0.006 (0.42)
Safety Programmed without Penalty	0.013 (0.50)	-0.007 (0.25)	0.030 (1.10)
Safety Complaint with Penalty	-0.020 (0.88)	-0.031 (1.39)	0.011 (0.49)
Safety Complaint without Penalty	0.032 (1.00)	0.019 (0.60)	-0.009 (0.28)
N	23,319	23,319	23,319
RMSE	0.703	0.695	0.725
RSQUARE	0.081	0.062	0.020

Notes: 't' statistics in parentheses

All regressions include controls for year, 2-digit SIC, and changes in employment and hours.

*** statistically significant at .01; ** at .05; * at .10, all 2-tailed

Table II-6

**The Percentage of Inspections Resulting in Penalties, by Inspection
Type and Establishment Size**

a. Federal

<u>Establishment Employment</u>	<u>Safety Programmed</u>	<u>Safety Complaint</u>	<u>Health Programmed</u>	<u>Health Complaint</u>	<u>Total</u>
<100	88% (407)	73% (159)	77% (149)	76% (158)	81% (873)
100-249	85% (427)	68% (361)	71% (219)	60% (369)	72% (1376)
250-499	83% (379)	62% (419)	63% (197)	53% (482)	65% (1477)
500+	82% (332)	54% (1309)	62% (199)	42% (1224)	53% (3064)
Total	85% (1545)	59% (2248)	68% (764)	50% (2233)	63% (6790)

b. State Plan

<u>Establishment Employment</u>	<u>Safety Programmed</u>	<u>Safety Complaint</u>	<u>Health Programmed</u>	<u>Health Complaint</u>	<u>Total</u>
<100	66% (1124)	61% (302)	56% (248)	53% (243)	62% (1189)
100-249	72% (1075)	49% (572)	61% (231)	45% (563)	59% (2441)
250-499	73% (846)	49% (560)	59% (167)	38% (644)	56% (2217)
500+	74% (728)	43% (1363)	54% (192)	30% (1422)	45% (3705)
Total	71% (3773)	47% (2797)	58% (838)	37% (2872)	54% (10280)

Notes: The number of observations with this inspection type and workplace size is in parentheses.
Source: Matched BLS Survey/OSHA IMIS sample of manufacturing establishments, 1990-98.

Table II-7

**The Effect of Inspections with Penalties in Different Manufacturing Industries,
DAW Injuries in Establishments<250**

Industry	IPENX	t stat
SIC21	-0.032	(0.86)
SIC22	-0.001	(0.02)
SIC23	-0.031	(0.50)
SIC24	-0.033	(0.95)
SIC25	-0.043	(0.72)
SIC26	-0.010	(0.18)
SIC27	-0.014	(0.30)
SIC28	*-0.115	(1.78)
SIC29	-0.044	(0.35)
SIC30	-0.062	(1.39)
SIC31	0.071	(0.67)
SIC32	-0.070	(0.34)
SIC33	-0.041	(0.79)
SIC34	*0.053	(1.70)
SIC35	-0.030	(0.98)
SIC36	-0.030	(0.47)
SIC37	-0.062	(0.96)
SIC38	0.034	(0.30)
SIC39	-0.080	(1.53)

Notes: 't' statistics in parentheses.

* statistically significant at .10

Results based on a single regression interacting IPENX and industry without an industry dummy variable. Includes controls for year and changes in employment and hours.

Table II-8

**The Effect of Inspections with Penalties at
Unionized Establishments**

	LWD <u>Injuries</u>	DAW <u>Injuries</u>	RWA <u>Injuries</u>
IPENX-State (Inspection with penalty=1)	-0.017 (1.36)	-0.013 (1.03)	-0.011 (0.70)
UNIIPENX-State (Interaction of IPENX-State and ANYUNION=1)	0.010 (0.50)	0.004 (0.21)	0.024 (1.01)
IPENX-Federal (Inspection with penalty=1)	**-0.029 (2.06)	-0.020 (1.35)	*-0.030 (1.74)
UNIIPENX-Federal Interaction of IPENX-Federal and ANYUNION=1	0.030 (1.46)	-0.001 (0.07)	**0.057 (2.21)
ANYUNION (Union at workplace=1)	-0.013 (1.17)	-0.005 (0.46)	-0.019 (1.39)
NEVERINS (never inspected=1)	**-0.019 (2.48)	-0.006 (0.70)	***-0.027 (2.82)
N	50,276	50,276	50,276
RMSE	0.641	0.665	0.800
RSQUARE	0.092	0.064	0.027

Notes: 't' statistics in parentheses

All regressions also included controls for year, 2 digit SIC, and employment and hours changes.

*** statistically significant at .01; ** at .05; * at .10

Table II-9**Effects of Inspections with Penalties in Selected States, Establishments with Fewer than 250 Workers**

	<u>LWD</u>	<u>DAW</u>	<u>RWA</u>
IPENX-Rest of Country	-0.019 (1.40)	*-0.026 (1.89)	0.002 (0.15)
IPENX-California	-0.033 (0.74)	-0.057 (1.28)	0.147 (0.32)
IPENX-Indiana	0.014 (0.30)	0.013 (0.26)	0.053 (1.06)
IPENX-Kentucky	0.033 (0.73)	0.005 (0.11)	*0.090 (1.92)
IPENX-Michigan	0.042 (1.13)	0.034 (0.94)	0.031 (0.82)
IPENX-NCarolina	-0.032 (0.56)	-0.057 (1.01)	0.058 (0.98)
IPENX-Tennessee	-0.052 (0.89)	-0.090 (1.54)	0.043 (0.71)
IPENX-Washington	-0.035 (0.85)	-0.050 (1.22)	0.002 (0.06)

Notes: 't' statistics in parentheses

These 3 regressions also included controls for year, SIC, change in employment, and change in hours. *statistically significant at the .10 level

Table III-1

The Effect of Penalty Inspections On Different Injury Event Types for Days Away from Work (DAW) Injuries, 1992-98 Manufacturing in Establishments with Fewer than 250 Workers

	<u>IPENX Coefficient</u> (t statistic)
DLINJA1 Struck-by	-0.006 (-0.68)
DLINJA2 Caught-in	-0.007 (-0.94)
DLINJA3 Falls from heights	0.000 (0.01)
DLINJA4 Eye abrasions	-0.009* (-1.92)
DLINJA5 Caught-in machinery	0.006 (0.96)
DLINJA6 Toxic substance	-0.010* (-1.93)
DLINJB1 Strains and overexertion	-0.026** (-2.51)
DLINJB2 Struck against	-0.016** (-2.12)
DLINJB3 Fall on same level	-0.003 (-0.49)

Notes: Each coefficient is from a separate regression. All had controls for employment and hours worked, year, and 2-digit SIC. The N for all was 23,395. IPENX=1 if there was an inspection with a penalty in the year for which we had injury change data or any of the 3 preceding years. *=significant at 0.10, two-tails; **=significant at 0.05.

Section Break (Continuous)

Table III-2
The Effect of Citing Particular Violations on Different Types of Injuries, Federal States,
All Violations Entered Together

	DLINJA1 Struckby	DLINJA2 Caughtin	DLINJA3 Highfall	DLINJA4 Eye	DLINJA5 Caught-mch	DLINJB1 Exertion	DLINJB2 Struckag	DLINJB3 Fallsame
Employment under 250								
IPENA1X	0.014	0.010	-0.025	-0.005	0.006	-0.028	-0.011	-0.017
machine guarding, general	0.63	0.52	-2.36	-0.45	0.4	-1.03	-0.56	-0.89
IPENA2X	-0.014	-0.064	0.027	-0.061	-0.043	-0.073	0.002	-0.019
personal protection, general	-0.42	-2.06	1.63	-3.47	-1.71	-1.71	0.07	-0.65
IPENA3X	-0.014	0.018	0.008	0.004	0.026	0.015	-0.014	0.002
electrical wiring	-0.55	0.78	0.6	0.3	1.37	0.46	-0.61	0.07
IPENA4X	0.029	-0.024	0.003	-0.005	-0.004	-0.013	-0.026	0.032
industrial trucks	0.78	-0.68	0.17	-0.25	-0.13	-0.28	-0.76	0.96
IPENA5X	-0.023	-0.002	0.014	-0.006	-0.009	-0.031	0.045	0.009
fire extinguishers	-0.69	-0.08	0.87	-0.36	0.37	0.75	1.55	0.33
Employment over 249								
IPENA1X	0.012	0.006	0.012	-0.001	0.012	-0.010	0.004	0.020
machine guarding, general	0.58	0.29	0.87	-0.12	0.72	-0.44	0.19	0.99
IPENA2X	-0.041	-0.051	0.033	-0.007	-0.019	-0.037	0.012	0.028
personal protection, general	-1.49	-1.94	1.83	-0.42	-0.87	-1.18	0.47	-1.03
IPENA3X	-0.006	-0.005	-0.010	-0.017	0.004	0.006	-0.016	-0.004
electrical wiring	-0.24	-0.21	-0.61	-1.19	0.19	0.2	-0.68	-0.17
IPENA4X	0.003	-0.010	-0.030	0.006	-0.024	0.001	0.010	-0.017
industrial trucks	0.09	-0.34	-1.4	0.31	-0.94	0.03	0.31	-0.54
IPENA5X	0.017	0.007	0.018	0.03	-0.014	0.012	-0.009	0.003
fire extinguishers	0.51	0.23	0.81	1.55	-0.52	0.33	-0.3	0.08

Bold indicates statistical significance at the 0.05 level, 2 tails. Underline indicates significance at the 0.10 level. "t" statistics are underneath the coefficients.

Discussion

Comparison of Inspection Impacts in Three Periods, 1979-1998

The initial regression results presented in Tables 2 and 3 provide evidence of a substantial decline between 1979 and 1998 in the measured impact of OSHA inspections on manufacturing industries: from a 15% reduction over the three years after an inspection with penalty in Period 1, to a 1% reduction in Period 3. In this section we consider several possible explanations for the decline, based on changes in OSHA policy and injury reporting during this time, and relate them to our statistical results.

One explanation for the decline could be a composition effect, with the data for Period 3 inspections containing more observations where OSHA's impact is small. Table 5 does show a smaller impact for large plants, which are more common in our data for Period 3 than they were in Period 1. This turns out to be offset by shifts in other groups, so the predicted average impact is actually higher in Period 3.¹ More importantly, the results for all subgroups of the data show that the decline in OSHA's impact is widespread, affecting different inspection types, plant sizes, and industries, so it is unlikely that any composition effects could tell the whole story.

Other explanations for the decline could arise from measurement issues. During most of Period 1 (from 1981 to 1986) OSHA inspectors on programmed inspections followed a "records-check" procedure: first checking a workplace's lost workday injury and illness rate, and terminating the inspection if the rate was below the manufacturing average. Such "records-only" inspections never imposed penalties, so firms wishing to avoid OSHA inspections had an incentive to under-report injuries. Ruser and Smith (1988, 1991) found evidence that lost workday rates fell for some plants subject to these inspections, but only for uninspected establishments. This would lead our results to understate (not overstate) the impact of inspections on injuries in the earlier period.

Injury reporting might also have been affected by OSHA's "egregious case" policy, which started levying extremely large and highly publicized fines for recordkeeping violations in 1986; if underreporting declined more at inspected establishments than uninspected ones this would translate into a smaller observed OSHA impact. Still, this seems unlikely to have played a large role in the observed decline, and should have affected the Period 2 impacts, not the continuing decline in Period 3.

Another reason why OSHA's records-check policy might affect our cross-period comparison is that plants with penalty inspections would tend to have high pre-inspection rates (since they weren't records-only), possibly leading to declining injuries after the inspection by regression to the mean. Scholz and Gray (1990) account for this using a model with autoregressive errors and find that there was evidence of negative autoregression (consistent with regression to the mean), but that the estimated OSHA

¹ Obtained by multiplying the Period 1 coefficients for each size group in Table 5 by that group's share of plants in each of the periods from Table 1.

impacts were not affected. As noted earlier, we also examined autoregressive models and found they didn't affect our results. Even if regression to the mean led us to overstate our Period 1 results, that should have led the decline in OSHA's impact in later periods to be concentrated in the results for programmed inspections, and to happen by Period 2. Table 4 shows a greater decline in the 1980s for complaint inspections with penalty, which were not subject to the records-check policy; the decline in impact for programmed inspections doesn't come until the 1990s, well after the records-check policy was being discontinued.

A final reporting issue arises due to the steady growth since the mid-1980s in the percentage of lost workday injuries that are classified as "restricted work activity" cases rather than as cases with "days away from work." As Figure 1 showed, the rate of RWA cases grew very slowly until the mid 1980s, then almost doubled in the 2 years from 1986 to 1988 and continued growing at over 10% per year until 1995. Thus by 1996 about ½ of all lost workday cases in manufacturing did not involve days away from work. We saw in Table 8 that in every period, even 1979-85, OSHA inspections with penalties had no preventive impact on the percentage change in the number of RWA injuries. Based on an assumption of zero impact on RWA cases, over one-third of the drop in OSHA's impact could be accounted for by the growth of RWA cases. Of course, this is an explanation only in an accounting sense; it provides no causal insights about why RWA cases have not been affected. Indeed, since the growth in RWA cases in the more recent periods presumably comes from cases that formerly would have been DAW cases, it is a puzzle why they are not affected similarly by OSHA inspections.

We now turn to explanations for the decline in OSHA's impact that do not rely on reporting changes or mismeasurement issues. A large increase in general deterrence could in theory weaken the impact of specific deterrence that we measure, but the evidence in Table 7 goes the other way: higher industry inspection rates are associated with more negative (larger) inspection-specific impacts. This reversed sign (if believable) could explain a small part of the decline in impact by the 1990s, when the number of inspections fell by more than one-third and total penalties fell as well.

Another possible explanation is declining marginal effectiveness of repeated inspections at the same workplace. Evidence for this has been found in past research (Weil (2001), Gray and Jones (1991)). Since larger establishments are inspected more frequently, the greater erosion in effectiveness that we find in the largest size group from Period 1 to Period 2 and then in the next largest from Period 2 to Period 3 is consistent with declining marginal effectiveness. The problem with this explanation is that OSHA had been conducting inspections for nearly a decade before our Period 1, and the declining impact of repeated inspections is most pronounced in the first few inspections, so most of the decline in impact at large, frequently inspected plants should have already occurred by the start of our data in 1979.

A somewhat different explanation for declining effectiveness of inspections could be that the standards that OSHA enforces have become less relevant to injury prevention over time. Most of these standards date from the 1960s or earlier. Changes in

manufacturing technologies may have left many of the standards outdated or irrelevant. As a result, we could find either that fewer violations are being detected or that violations are relevant to a shrinking percentage of injuries.

The number of violations cited per manufacturing inspection has not changed very much, which raises doubts about the first of these predictions. The second is harder to assess. On the assumption that new capital equipment is safer than the old equipment, Table 7 did examine the rate of investment in each of the (2-digit) manufacturing industries from 1979 to 1998 and compared it to the estimated coefficients on the impact of inspections with penalties in each industry in each of the 3 periods. For coefficients based on all establishments in our sample, the relationship was positive, with borderline statistical significance. The positive relationship indicated that higher investment in an industry reduced the impact of inspections with penalties. However, when we estimated the industry-IPENX interactions for establishments with fewer than 250 workers (because those were the establishments with some indication of Period 3 effects) we found no relation to investment levels.

A more promising explanation is that rising costs for workers' compensation may have stimulated employers to increase their efforts to a) prevent injuries, b) discourage workers from making claims, and c) manage the disability process more closely to reduce the costs of claims. Workers' compensation benefits had risen steadily as a percentage of payroll through the 1980s, peaked in 1992 at 1.66% and then fell steadily to 1.08% by 1998.²⁵ Slower growth in medical costs after 1992 aided the slowdown, but so did the drop in the lost workday injury rate, a drop that was unprecedented for a period of strong economic growth.

The reasoning behind this explanation is that if employers were making especially strong efforts to limit injury losses during this period, then it is plausible that the extra spur provided by an OSHA inspection would have had relatively little impact. This explanation is difficult to assess because we cannot measure changes in the intensity of employer safety efforts. We could look at the relationship between compensation costs in a state and reported injury rates in that state, but we would not know whether any relationship was due to injury prevention, claims prevention, or claims management.

Compared to the previous three explanations, this one's impact should be less focused on the prevention of injuries through compliance with standards. Employers would have greater incentives to prevent all types of injuries and to do so any way they could. We do not have data on injury types before 1992. Since 1992, the reduction in days away from work injuries (the only category for which we have injury type data) occurred fairly uniformly across different injury types in manufacturing, as shown in Table 9. To the extent that there were differences, the injury types generally believed to be more related to standards (e.g., "caught-in" injuries and falls from heights) had less of a decline than those believed to be less related to standards (e.g., "bodily reaction" (overexertion) injuries). This is consistent with a hypothesis that general financial incentives like workers' compensation, rather than inspections, caused the change.

Finally, there may have been some changes in what actually goes on during inspections. In the 1990s, especially after mid-1995, OSHA management de-emphasized the importance of numerical measures of inspection activities (e.g., violations cited). It placed more emphasis on problem solving and being more creative in encouraging firms to reduce workplace hazards. This has led overall to fewer inspections taking more hours of inspector time. One might have expected that these changes would have made individual inspections more effective, but we find less impact of inspections during the 1990s.

After examining a variety of reasons for the decline in impact of OSHA inspections on injuries, we have only found partial explanations. Some possibilities, such as changes in data composition, OSHA's records-check policy, and general deterrence, explain very little or even go the other way. The growth in restricted work activity injuries can explain one-third of the decline in an accounting sense, but it's not clear why these injuries would be less affected. The most promising explanation seems to be related to the dramatic increases in workers' compensation costs, which might have led all employers to pay more attention to safety hazards, reducing the incremental incentives to improve safety provided by OSHA inspections.

Detailed Review of Inspection Impacts in 1992-1998

The larger sample obtained when we look at both state plan and federal OSHA inspections appears to contribute toward making the effect of inspections more statistically significant. We find this result even though the effect of inspections is no different in state plan states than it is in federal OSHA states. However, we do find a somewhat different size pattern of effects. In the full sample, we find that the strongest effects of inspections occur in establishments with under 100 workers, rather than in the 100-249 size category, as we found in the federal state sample.

Because state plan programs conduct over 50% more inspections per manufacturing establishment than federal OSHA programs, the absence of any difference in effectiveness per inspection between state plan and federal OSHA inspections suggests that the total impact of inspections is greater in state plan states. The average penalty per inspection is greater in federal OSHA programs, which might offset some of the greater probability of inspection in state plan programs. Overall, the expected penalty is fairly similar in the two groups of states. To the extent that deterrence depends on this expected penalty (the probability of inspection times the average penalty if inspected), we might expect that deterrence would be roughly equal. To the extent that higher general deterrence should reduce the impact of actually being inspected, we should not expect much difference in the two regions in the latter.

The failure to find lower inspection impacts in state plan states, despite their higher inspection frequencies, does raise some question about the declining marginal effectiveness argument. Establishments in these states have been inspected more frequently, yet we don't see any sizable difference in the effectiveness of individual inspections.

The finding that inspections have their greatest impact at workplaces with fewer than 100 workers may suggest that more inspections should be targeted there. However, it must be kept in mind that, e.g., a 20% reduction in injuries at a workplace with 50 workers and 5 injuries prevents 1 injury, while a 10% reduction at a workplace with 400 workers and 30 injuries prevents 3 injuries. Thus, the limitation of effectiveness to smaller workplaces seriously reduces the ability of the OSHA inspection program to prevent injuries

In addition, the finding that inspections without penalties can actually increase reported injuries requires that we consider whether, on balance, inspections reduce or increase injuries. Again, if a penalty inspection decreases injuries by 20% at a workplace with 50 workers, but a non-penalty inspection increases injuries at a workplace with 400 workers by even 5%, the net effect of inspections would be one *additional* injury.

We saw that when we controlled for the effects of unions on inspection outcomes, the IPENX coefficient became considerably more significant and negative in federal states. For some reason, inspections in federal states led to increases in restricted work activity injuries at unionized workplaces but led to decreases at non-unionized workplaces. As we noted above, it is difficult to believe that this result really reflects differences in the preventive effects of inspections. Instead, it probably reflects something about management practices in responses to inspections. But further investigations into labor-management practices will be necessary to reach a better understanding. If the growth in RWA injuries reflected primarily a greater substitution for DAW injuries, then we would also expect to find steeper drops in DAW injuries at these workplaces, but we instead find smaller decreases in DAW injuries than at non-union workplaces. In state plan states, we find the same pattern, but it is much less striking and the differences are not statistically significant. That difference from the findings for federal states suggests that we still need to hedge our conclusions about the effects of unions. One other point to keep in mind is that these regressions did not control for size of establishment. Larger establishments are more likely to be unionized, more likely to have RWA programs, and less likely to be see preventive effects on DAW injuries from inspections.

When we compared programmed, complaint, and referral inspection types, we found none which had statistically significant effects on the LWD rate. For DAW injuries, in contrast, the coefficients for complaint inspections were usually significant. This pattern persisted even when we included establishments with more than 250 workers. One possibly confounding factor might be that complaint inspections are more likely when a plant has injuries or has a higher than usual number of injuries. Other studies have found that the workplaces that complaint inspections take OSHA to have higher injury rates than the average establishment in the 4-digit SIC, even after adjusting for size (Mendeloff, 1997). However, it is not known whether that higher injury rate was persistent or whether it represented a temporary upward blip. In the latter case, the drop in injuries following inspections could represent an artifact caused by regression to the mean. However, if this were true, we would expect to see the decline regardless of

whether there had been a penalty assessed. In fact, penalties change the coefficient for complaint inspections on LWD injuries almost as much as they change the coefficient of programmed inspections, 0.15 for the former and 0.20 for the latter. Thus it seems unlikely that the effect of complaint inspections is primarily due to a regression-to-the-mean process.

One quite unexpected, indeed paradoxical, finding was that health inspections had more preventive impact on injuries than safety inspections. The effects on LWDs were significant only for programmed health inspections with penalty, although programmed complaint inspections had the next biggest effect and had by far the largest impact on DAW injuries. We saw that health inspections were not disproportionately carried out at small workplaces, so the effect is unlikely to be confounded with size. We should note that many OSHA inspectors are “cross-trained” to inspect for both health and safety hazards and many inspections that are labeled as “health” do cite safety violations, although not as many as safety inspections do. One explanation might be the greater time that inspectors remain on site during health inspections; during the years in our sample, the total hours for safety inspections averaged about 20 while those for health inspections averaged about 40. Not all of this difference represents time spent on-site, but a substantial portion does. While they are waiting for their health sampling to be completed, they may have more time for extensive reviews of the plant and interactions with personnel. Even if they don’t cite more violations, they may be able to have more of a personal impact. This explanation is, of course, quite speculative. Nevertheless, it seems evident that the benefits of health inspections are not necessarily limited to uncovering or correcting health hazards. This finding may be important because critics have sometimes complained that health inspections have little pay-off because they so rarely find that workers are overexposed to health hazards.

Discussion of Effects of Inspections and Citations on Particular Injury Event Types

The analyses carried out on these issues were designed to shed light on the question of *how* OSHA inspections prevent injuries. Some of the possible mechanisms would appear to primarily affect injury types where compliance with standards could prevent a sizable share of the injuries. This is true of the straightforward mechanism where inspectors detect and cite violations of standards; employers therefore correct the hazards, and the injuries those hazards would have caused are prevented. It is probably also true of the general deterrence mechanism, where the threat of inspection and the expected penalty for a violation induces firms to comply (although this assumes that managers know what they have to do to avoid penalties). However, the findings in Table III-1 show that the largest effect of penalty inspections is on the injury type—bodily reactions and exertions—that clearly has little relation to standards that OSHA enforces.

This finding strongly suggests that other mechanisms must be at work. One could be the behavioral model suggested by Scholz and Gray (1997) in this context and growing out of the work of Cyert and March (1963). According to this model, inspections that levy penalties provide a surprising negative message to managers. The magnitude of the fine may or may not be a major concern, but they are upset that they are being charged with dereliction in responsibility for their employees. They may react to

the fine not simply by complying with citations, but by giving greater attention to safety issues more generally, perhaps in order to restore their self-image that they are responsible managers. But managerial time is limited and although some types of new behavior may be reinforced by new rules and institutions, the priority given to safety is likely to slip as other hot issues arise. A similar process has been suggested for the role of injuries themselves. When injuries go up, managers focus on the problem; when they go down, attention goes to other issues. This latter process, unlike the one triggered by penalties, could create a pattern like that attributed to purely statistical factors.

The findings in Tables III-1 and III-2 do not, however, rule out the possibility that the more direct and traditional “detection/correction” mechanism plays some role as well. The tightly estimated effect of the PPE standard on the prevention of eye abrasions seems to present one example. When we look at the effects of the PPE standard, rather than the effects of an inspection with penalty, we find that the effects on the “type A” injuries become larger and more precisely estimated in relation to the effects on “type B” injuries.

Acknowledgements

We are grateful to several agencies for financial support. The National Institute of Occupational Safety and Health (R01-OH03895-03) grant supported all of the analysis and the creation of the 1992-98 data set. The National Science Foundation (SES-8420920) supported the creation of the 1979-85 data, and to the Bureau of Labor Statistics (research contract J-9-J-5-0085) supported the creation of the 1987-91 data. We would also like to thank John Ruser, John Scholz, and David Weil for valuable comments on an earlier draft of this manuscript, and Nichola Thomson, Si Kyung Seong, and Chan Woo Lee for research assistance. All research papers using Bureau of Labor Statistics microdata are screened to ensure no confidential data is revealed. The results and conclusions expressed (as well as any remaining errors) are the authors', and not those of any of the supporting agencies.

At OSHA Joe DuBois helped us getting access to data there. Chris Chapman handled the administrative work of obtaining access to BLS data. Several OSHA staff gave us comments on our early findings, including Paul Bolon, Robert Burt, Joe DuBois, Richard Fairfax, Marthe Kent, John Martonik, and Bill Perry.

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Anticipated Future Publications

- 1) WB Gray and JM Mendeloff, The Declining Effects of OSHA Inspections on Manufacturing Injuries: 1979-1998.
(This manuscript has been given a revise and resubmit. It is also available as Working Paper 9119 on the National Bureau of Economic Research website, nber.org)
- 2) JM Mendeloff and WB Gray, How Characteristics of Inspections and Workplaces Affect the Injury Prevention Outcomes of OSHA Inspections
- 3) JM Mendeloff and WB Gray, Why Do OSHA Inspections Prevent Injuries? A Test of the Detection/Correction Mechanism versus a Behavioral Mechanism
- 4) WB Gray and JM Mendeloff, The Effectiveness of OSHA Inspections: Directions for Future Research

Appendices

- I. BLS Injury Event Codes**
- II. Event or exposure and industry division, Days Away from work counts, 1994 (BLS Survey of Occupations Injuries and Illnesses)**
- III. Matching of injury event codes and OSHA standards**
- IV. Means for 16,036 establishments in sample**

Appendix I

forcible contact are classified in Division 0 and 1. Bodily reactions and exposures are classified in Divisions 2 and 3. Transportation accidents, fires and explosions, and assaults and violent acts follow in Divisions 4 through 6 respectively.

The Event or Exposure divisions are arranged as follows:

DIVISION & TITLE

0 Contact With Objects and Equipment
1 Falls
2 Bodily Reaction and Exertion
3 Exposure to Harmful Substances or Environments
4 Transportation Accidents
5 Fires and Explosions
6 Assaults and Violent Acts
9 Other Events or Exposures
9999 Nonclassifiable
0* CONTACT WITH OBJECTS AND EQUIPMENT
00 Contact with objects and equipment, unspecified
01* Struck against object
010 Struck against object, unspecified
011 Stepped on object
012 Struck against stationary object
013 Struck against moving object
019 Struck against object, n.e.c.
02* Struck by object
020 Struck by object, unspecified
021 Struck by falling object
022* Struck by flying object
0220 Struck by flying object, unspecified
0221 Struck by dislodged flying object, particle
0222 Struck by discharged object or substance
0229 Struck by flying object, n.e.c.
023* Struck by swinging or slipping object
0230 Struck by swinging or slipping object, unspecified
0231 Struck by or slammed in swinging door or gate
0232 Struck by slipping handheld object
0239 Struck by swinging or slipping object, n.e.c.
024 Struck by rolling, sliding objects on floor or ground level
029 Struck by object, n.e.c.
03* Caught in or compressed by equipment or objects
030 Caught in or compressed by equipment or objects, unspecified
031 Caught in running equipment or machinery
032 Compressed or pinched by rolling, sliding, or shifting objects
039 Caught in or compressed by equipment or objects, n.e.c.
04* Caught in or crushed in collapsing materials
040 Caught in or crushed in collapsing materials, unspecified
041 Excavation or trenching cave-in
042 Other cave-in
043 Landslide
044 Caught in or crushed in collapsing structure
049 Caught in or crushed in collapsing materials, n.e.c.
05* Rubbed or abraded by friction or pressure
050 Rubbed or abraded by friction or pressure, unspecified
051 Rubbed or abraded by kneeling on surface
052 Rubbed or abraded by objects being handled
053 Rubbed or abraded by foreign matter in eye
059 Rubbed or abraded by friction or pressure, n.e.c.
06* Rubbed, abraded, or jarred by vibration

060 Rubbed, abraded, or jarred by vibration, unspecified
061 Rubbed, abraded, or jarred by vehicle or mobile equipment vibration
062 Rubbed, abraded, or jarred by other machine or equipment vibration
069 Rubbed, abraded, or jarred by vibration, n.e.c.
09 Contact with objects and equipment, n.e.c.
1* FALLS
10 Fall, unspecified
11* Fall to lower level
110 Fall to lower level, unspecified
111 Fall down stairs or steps
112* Fall from floor, dock, or ground level
1120 Fall from floor, dock, or ground level, unspecified
1121 Fall through existing floor opening
1122 Fall through floor surface
1123 Fall from loading dock
1124 Fall from ground level to lower level
1129 Fall from floor, dock, or ground level, n.e.c.
113 Fall from ladder
114 Fall from piled or stacked material
115* Fall from roof
1150 Fall from roof, unspecified
1151 Fall through existing roof opening
1152 Fall through roof surface
1153 Fall through skylight
1154 Fall from roof edge
1159 Fall from roof, n.e.c.
116 Fall from scaffold, staging
117 Fall from building girders or other structural steel
118 Fall from nonmoving vehicle
119 Fall to lower level, n.e.c.
12* Jump to lower level
120 Jump to lower level, unspecified
121 Jump from scaffold, platform, loading dock
122 Jump from structure, structural element, n.e.c.
123 Jump from nonmoving vehicle
129 Jump to lower level, n.e.c.
13* Fall on same level
130 Fall on same level, unspecified
131 Fall to floor, walkway, or other surface
132 Fall onto or against objects
139 Fall on same level, n.e.c.
19 Fall, n.e.c.
2* BODILY REACTION AND EXERTION
20 Bodily reaction and exertion, unspecified
21* Bodily reaction
210 Bodily reaction, unspecified
211 Bending, climbing, crawling, reaching, twisting
212 Sudden reaction when surprised, frightened, startled
213 Running--without other incident
214 Sitting
215 Slip, trip, loss of balance--without fall
216 Standing
217 Walking--without other incident
219 Bodily reaction, n.e.c.
22* Overexertion
220 Overexertion, unspecified
221 Overexertion in lifting
222 Overexertion in pulling or pushing objects
223 Overexertion in holding, carrying, turning, or wielding objects
224 Overexertion in throwing objects

229 Overexertion, n.e.c.
23* Repetitive motion
230 Repetitive motion, unspecified
231 Typing or keyentry
232 Repetitive use of tools
233 Repetitive placing, grasping, or moving objects, except tools
239 Repetitive motion, n.e.c.
24 Sustained viewing
25 Bodily conditions, n.e.c.
29 Bodily reaction and exertion, n.e.c.
3* EXPOSURE TO HARMFUL SUBSTANCES OR ENVIRONMENTS
30 Exposure to harmful substances or environments, unspecified
31* Contact with electric current
310 Contact with electric current, unspecified
311 Contact with electric current of machine, tool, appliance, or light fixture
312 Contact with wiring, transformers, or other electrical components
313 Contact with overhead power lines
314 Contact with underground, buried power lines
315 Struck by lightning
319 Contact with electric current, n.e.c.
32* Contact with temperature extremes
320 Contact with temperature extremes, unspecified
321 Exposure to environmental heat
322 Exposure to environmental cold
323 Contact with hot objects or substances
324 Contact with cold objects or substances
33* Exposure to air pressure changes
330 Exposure to air pressure change, unspecified
331 Pressure changes underwater
332 Pressure changes in airplane, other aircraft
339 Exposure to air pressure change, n.e.c.
34* Exposure to caustic, noxious, or allergenic substances
340 Exposure to caustic, noxious, or allergenic substances, unspecified
341* Inhalation of substance
3410 Inhalation of substance, unspecified
3411 Inhalation in enclosed, restricted, or confined space
3412 Inhalation in open or nonconfined space
342 Contact with skin or other exposed tissue
343* Injections, stings, venomous bites
3430 Injections, stings, venomous bites, unspecified
3431 Needle sticks
3432 Bee, wasp, hornet sting
3433 Other stings or venomous bites
3439 Injections, stings, venomous bites, n.e.c.
344 Ingestion of substance
349 Exposure to caustic, noxious, or allergenic substances, n.e.c.
35* Exposure to noise
350 Exposure to noise, unspecified
351 Exposure to noise over time
352 Exposure to noise in single incident
36* Exposure to radiation
360 Exposure to radiation, unspecified
361 Exposure to sun
362 Exposure to welding light
363 Exposure to radioactive material
369 Exposure to radiation, n.e.c.
37 Exposure to traumatic or stressful event, n.e.c.
38* Oxygen deficiency, n.e.c.
381 Drowning, submersion

382 Choking on object or substance
383 Depletion of oxygen from cave-in or collapsed materials
384 Depletion of oxygen in other enclosed, restricted, or confined space
389 Other oxygen deficiency, n.e.c.
39 Exposure to harmful substances or environments, n.e.c.
4* TRANSPORTATION ACCIDENTS
40 Transportation accident, unspecified
41* Highway accident
410 Highway accident, unspecified
411* Collision between vehicles, mobile equipment
4110 Collision between vehicles, mobile equipment, unspecified
4111 Re-entrant collision
4112 Moving in same direction
4113 Moving in opposite directions, oncoming
4114 Moving in intersection
4115 Moving and standing vehicle, mobile equipment--in roadway
4116 Moving and standing vehicle, mobile equipment--side of road
4119 Collision between vehicles, mobile equipment, n.e.c.
412 Vehicle struck stationary object or equipment in roadway
413 Vehicle struck stationary object, equipment on side of road
414* Noncollision accident
4140 Noncollision accident, unspecified
4141 Jack-knifed or overturned--no collision
4142 Ran off highway--no collision
4143 Struck by shifting load
4144 Sudden start or stop, n.e.c.
4149 Noncollision accident, n.e.c.
419 Highway accident, n.e.c.
42* Nonhighway accident, except rail, air, water
420 Nonhighway accident, unspecified
421 Collision between vehicles or mobile equipment
422 Vehicle, mobile equipment struck stationary object
423* Noncollision accident
4230 Noncollision accident, unspecified
4231 Fall from moving vehicle, mobile equipment
4232 Fell from and struck by vehicle, mobile equipment
4233 Overturned
4234 Loss of control
4235 Struck by shifting load
4236 Sudden start or stop, n.e.c.
4239 Noncollision accident, n.e.c.
429 Nonhighway accident, n.e.c.
43* Pedestrian, nonpassenger struck by vehicle, mobile equipment
430 Pedestrian struck by vehicle, mobile equipment, unspecified
431 Pedestrian struck by vehicle, mobile equipment in roadway
432 Pedestrian struck by vehicle, mobile equipment on side of road
433 Pedestrian struck by vehicle, mobile equipment in parking lot or
non-roadway
area
44* Railway accident
440 Railway accident, unspecified
441 Collision between railway vehicles
442 Collision between railway vehicle and other vehicle
443 Collision between railway vehicle and other object
444 Fell from and struck by railway vehicle
445 Derailment
446 Explosion, fire, n.e.c.
447 Fall in, on, or from railway vehicle in motion, n.e.c.
449 Railway accident, n.e.c.
45* Water vehicle accident

450 Water vehicle accident, unspecified
451 Collision
452 Explosion, fire, n.e.c.
453 Fall from ship, boat, n.e.c.
454 Fall on ship, boat
455 Sinking, capsized water vehicle
459 Water vehicle accident, n.e.c.
46* Aircraft accident
460 Aircraft accident, unspecified
461 During takeoff or landing
469 Aircraft accident, n.e.c.
49 Transportation accident, n.e.c.
5* FIRES AND EXPLOSIONS
50 Fire or explosion, unspecified
51* Fire--unintended or uncontrolled
510 Fire, unspecified
511 Fire in residence, building, or other structure
512 Forest, brush, or other outdoor fire
513 Ignition of clothing from controlled heat source
519 Fire, n.e.c.
52* Explosion
520 Explosion, unspecified
521 Explosion of battery
522 Explosion of pressure vessel or piping
529 Explosion, n.e.c.
6* ASSAULTS AND VIOLENT ACTS
60 Assaults and violent acts, unspecified
61* Assaults and violent acts by person(s)
610 Assaults and violent acts by person(s), unspecified
611 Biting
612 Hitting, kicking, beating
613 Shooting
614 Squeezing, pinching, scratching, twisting
615 Stabbing
616 Rape
617 Threats or verbal assaults
619 Assaults and violent acts by person(s), n.e.c.
62* Self-inflicted injury
620 Self-inflicted injury, unspecified
621 Suicide, attempted suicide
622 Self-inflicted injury or fatality--intent unknown
63* Assaults by animals
630 Assaults by animals, unspecified
631 Nonvenomous bites
639 Assaults by animals, n.e.c.
9 OTHER EVENTS OR EXPOSURES
9999 Nonclassifiable

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Appendix II

Table 14. Event or exposure and industry division: Days-away-from-work case counts,¹ 1994

Event	Private industry ²	Goods-producing				Service-producing				
		Agriculture, forestry, and fishing ²	Mining ³	Construction	Manufacturing	Transportation and public utilities ³	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
Total	2,236,639	41,020	20,734	218,835	584,254	241,703	165,742	394,619	55,342	514,390
Contact with objects and equipment	607,073	13,380	8,283	72,894	196,220	51,223	46,700	112,047	10,304	96,023
Contact with objects and equipment, unspecified	8,739	301	11	966	2,078	1,401	503	1,979	189	1,312
Struck against object	162,269	3,412	1,948	18,488	47,139	13,170	11,514	33,191	3,504	29,907
Struck against object, unspecified	7,733	314	58	1,053	2,435	674	312	1,758	91	1,038
Stepped on object	16,067	410	48	3,788	4,739	1,889	1,194	1,745	360	1,894
Struck against stationary object	94,448	2,070	904	9,351	25,713	8,170	6,878	18,871	2,197	20,293
Struck against moving object	19,668	242	729	2,021	6,418	737	1,222	5,539	187	2,573
Struck against object, n.e.c.	24,354	378	210	2,272	7,834	1,699	1,908	5,277	669	4,109
Struck by object	292,609	6,439	4,138	38,306	82,851	26,042	23,548	59,245	4,914	47,127
Struck by object, unspecified	11,056	310	959	1,296	2,774	1,587	427	1,694	148	1,861
Struck by falling object	111,996	1,639	1,966	14,510	30,877	12,647	9,170	23,847	1,669	15,672
Struck by flying object	28,048	830	493	4,987	11,955	1,497	2,283	2,499	334	3,188
Struck by flying object, unspecified	2,394	24	386	274	844	128	222	189	32	294
Struck by dislodged flying object, particle	14,754	518	81	2,177	6,647	840	1,214	1,574	142	1,560
Struck by discharged object or substance	6,044	96	17	1,777	2,644	161	506	394	36	412
Struck by flying object, n.e.c.	4,855	191	9	759	1,820	388	341	342	125	901
Struck by swinging or slipping object	83,730	2,356	370	11,215	19,839	5,005	6,894	21,192	1,825	15,036
Struck by swinging or slipping object, unspecified	1,539	59	-	382	480	124	86	145	10	253
Struck by or slammed in swinging door or gate	13,140	176	7	856	1,587	1,624	1,108	2,799	408	4,576
Struck by slipping handheld object	56,706	1,503	287	8,144	14,270	2,089	4,048	16,843	1,239	8,281
Struck by swinging or slipping object, n.e.c.	12,346	618	76	1,833	3,501	1,168	1,652	1,404	168	1,926
Struck by rolling, sliding objects on floor or ground level	8,730	120	82	558	1,941	625	932	1,960	120	2,390
Struck by object, n.e.c.	49,051	1,184	267	5,741	15,464	4,683	3,841	8,054	818	9,000
Caught in or compressed by equipment or objects	95,907	2,002	1,883	8,776	46,853	6,537	7,763	12,056	991	11,247
Caught in or compressed by equipment or objects, unspecified	7,773	106	797	658	3,234	589	784	702	59	844
Caught in running equipment or machinery	36,475	663	53	1,517	22,978	608	2,708	4,441	215	3,291
Compressed or pinched by rolling, sliding, or shifting objects	17,278	499	288	1,338	6,480	1,888	1,454	2,522	293	2,517
Caught in or compressed by equipment or objects, n.e.c.	34,381	734	744	3,262	13,961	3,453	2,818	4,391	424	4,594
Caught in or crushed in collapsing materials	833	48	10	224	161	81	-	175	-	198
Excavation or trenching cave-in	240	43	8	136	25	-	-	-	-	-
Caught in or crushed in collapsing structure	287	-	-	54	43	-	-	79	-	60
Caught in or crushed in collapsing materials, n.e.c.	304	-	-	-	38	51	-	96	-	99
Rubbed or abraded by friction or pressure	37,805	910	200	6,800	15,139	2,717	2,769	4,095	548	4,626
Rubbed or abraded by friction or pressure, unspecified	178	-	21	-	81	-	-	20	-	34
Rubbed or abraded by kneeling on surface	1,323	72	-	430	303	112	53	147	19	187
Rubbed or abraded by objects being handled	1,254	30	-	124	506	108	82	135	-	261
Rubbed or abraded by foreign matter in eye	34,405	783	178	6,203	14,029	2,415	2,595	3,715	482	4,004
Rubbed or abraded by friction or pressure, n.e.c.	646	24	-	38	220	74	-	78	37	140
Rubbed, abraded, or jarred by vibration	3,408	104	38	765	718	852	305	215	41	372
Rubbed, abraded, or jarred by vibration, unspecified	140	-	17	-	16	-	-	-	-	45
Rubbed, abraded, or jarred by vehicle or mobile equipment vibration	2,031	55	20	325	441	757	242	109	17	64
Rubbed, abraded, or jarred by other machine or equipment vibration	874	46	-	353	197	56	51	-	16	110
Rubbed, abraded, or jarred by vibration, n.e.c.	363	-	-	61	64	36	-	-	-	152

See footnotes at end of table.

Table 14. Event or exposure and industry division: Days-away-from-work case counts,¹ 1994 — Continued

Event	Private industry ²	Goods-producing				Service-producing				
		Agriculture, forestry, and fishing ²	Mining ³	Construction	Manufacturing	Transportation and public utilities ³	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
Contact with objects and equipment, n.e.c.	5,403	164	54	572	1,482	424	264	1,090	119	1,234
Falls	393,308	7,425	4,035	45,850	66,146	44,879	26,010	82,346	14,560	102,058
Fall, unspecified	4,347	64	21	853	705	783	350	584	133	854
Fall to lower level	111,308	3,090	1,940	24,726	17,309	14,620	9,495	15,404	3,938	20,787
Fall to lower level, unspecified	1,814	20	39	469	337	312	102	108	18	411
Fall down stairs or steps	25,823	211	136	1,299	4,277	2,458	1,377	4,637	1,996	9,432
Fall from floor, dock, or ground level	6,404	123	83	1,831	1,337	967	633	500	137	793
Fall from floor, dock, or ground level, unspecified	433	-	-	53	106	113	89	-	8	30
Fall through existing floor opening	1,161	52	34	436	225	233	-	-	10	133
Fall through floor surface	943	10	34	469	161	37	-	65	8	122
Fall from loading dock	1,661	11	-	154	418	372	422	211	-	72
Fall from ground level to lower level	1,645	33	15	590	265	159	45	82	104	352
Fall from floor, dock, or ground level, n.e.c.	561	10	-	130	165	53	-	81	-	84
Fall from ladder	25,794	1,074	265	8,422	3,547	1,608	2,002	3,936	929	4,011
Fall from piled or stacked material	1,285	44	65	98	337	61	124	439	-	114
Fall from roof	4,398	10	7	3,382	217	62	269	111	204	135
Fall from roof, unspecified	1,455	-	-	1,256	38	30	-	-	10	41
Fall through existing roof opening	210	-	-	161	31	-	-	-	-	-
Fall through roof surface	495	-	-	226	55	18	97	-	-	64
Fall through skylight	102	-	-	85	12	-	-	-	-	-
Fall from roof edge	1,632	-	-	1,239	36	-	125	-	189	-
Fall from roof, n.e.c.	503	-	-	415	45	13	-	-	-	16
Fall from scaffold, staging	5,268	22	88	3,550	739	102	76	133	49	508
Fall from building girders or other structural steel	580	-	56	286	104	15	-	51	-	44
Fall from nonmoving vehicle	19,692	772	759	2,174	2,824	8,653	3,071	1,692	84	1,662
Fall to lower level, n.e.c.	20,249	813	443	3,214	3,569	2,382	1,616	3,796	517	3,678
Jump to lower level	10,778	447	94	1,864	2,452	2,058	1,375	1,080	99	1,308
Jump to lower level, unspecified	607	16	-	121	235	67	-	-	-	92
Jump from scaffold, platform, loading dock	1,258	8	17	186	369	88	323	96	9	161
Jump from structure, structural element, n.e.c.	853	26	-	154	282	76	82	113	-	114
Jump from nonmoving vehicle	4,502	327	8	632	808	1,152	596	436	54	490
Jump to lower level, n.e.c.	3,558	69	64	770	758	674	339	400	32	451
Fall on same level	265,578	3,755	1,980	18,330	45,362	27,238	14,738	65,116	10,368	78,692
Fall on same level, unspecified	3,297	14	-	353	566	1,159	106	504	27	563
Fall to floor, walkway, or other surface	227,200	2,986	1,556	13,410	36,288	22,328	12,171	58,704	9,338	70,420
Fall onto or against objects	32,892	723	418	4,121	8,159	3,414	2,356	5,548	892	7,261
Fall on same level, n.e.c.	2,190	32	-	446	350	336	105	360	111	447
Fall, n.e.c.	1,297	69	-	76	316	180	52	161	22	417
Bodily reaction and exertion	974,251	13,412	6,253	78,934	268,124	111,244	75,153	154,355	23,436	243,340
Bodily reaction and exertion, unspecified	13,171	383	6	930	2,814	2,749	754	2,440	282	2,812
Bodily reaction	240,039	5,028	700	23,775	81,263	30,568	17,440	37,858	5,749	57,662
Bodily reaction, unspecified	8,520	138	16	748	2,052	1,094	612	1,195	156	2,510
Bending, climbing, crawling, reaching, twisting	89,494	1,564	215	8,912	25,734	8,924	6,183	14,917	2,076	20,971
Sudden reaction when surprised, frightened, startled	1,959	26	12	262	581	183	110	313	17	475
Running—without other incident	1,771	31	6	94	193	210	51	202	88	917
Sitting	1,502	-	-	39	358	313	65	78	264	379
Slip, trip, loss of balance—without fall	72,542	1,582	201	6,735	16,447	9,508	4,921	13,006	1,832	16,329
Standing	2,681	28	-	188	849	228	209	543	80	553
Walking—without other incident	6,715	259	76	779	1,770	1,188	510	1,341	310	2,483
Bodily reaction, n.e.c.	52,856	1,412	189	6,019	13,302	8,921	4,778	6,283	948	11,046
Overexertion	613,251	7,076	5,424	49,913	151,794	71,025	50,918	100,667	11,191	165,244
Overexertion, unspecified	48,950	571	43	3,230	11,885	6,366	4,403	6,546	808	15,300
Overexertion in lifting	367,424	4,024	2,142	28,492	86,166	42,489	33,078	70,157	6,618	94,059
Overexertion in pulling or pushing objects	93,325	1,344	810	6,883	29,159	12,373	7,536	11,356	1,612	22,251
Overexertion in holding, carrying, turning, or welding objects	68,992	705	300	8,149	16,567	6,395	3,960	8,678	1,534	22,702
Overexertion in throwing objects	2,533	97	-	286	742	399	241	320	16	432
Overexertion, n.e.c.	32,027	335	2,128	2,873	7,474	3,003	1,701	3,609	404	10,500
Repetitive motion	92,576	715	104	3,300	49,278	5,576	4,707	10,531	5,046	13,319
Repetitive motion, unspecified	23,343	173	29	1,016	12,932	1,155	1,210	3,014	727	3,086

See footnotes at end of table.

Table 14. Event or exposure and industry division: Days-away-from-work case counts,¹ 1994 — Continued

Event	Private industry ²	Goods-producing				Service-producing				
		Agriculture, forestry, and fishing ²	Mining ³	Construction	Manufacturing	Transportation and public utilities ³	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
Typing or keyentry	13,252	22	37	64	1,848	2,251	741	1,288	3,132	3,868
Repetitive use of tools	12,764	156	12	1,060	8,413	291	541	1,004	168	1,117
Repetitive placing, grasping, or moving objects, except tools	31,085	251	16	721	20,303	1,237	1,668	3,610	571	2,709
Repetitive motion, n.e.c.	12,132	112	9	438	5,782	642	548	1,615	447	2,539
Sustained viewing	90	-	-	-	-	41	-	-	16	-
Bodily conditions, n.e.c.	6,149	47	10	221	822	497	693	1,201	619	1,839
Bodily reaction and exertion, n.e.c.	8,976	165	9	794	2,150	789	641	1,651	333	2,443
Exposure to harmful substances or environments	110,943	2,128	964	9,792	31,666	7,463	5,218	24,421	2,614	26,676
Exposure to harmful substances or environments, unspecified	286	-	-	-	104	37	-	52	-	72
Contact with electric current	6,016	66	38	1,309	1,276	451	204	1,684	182	808
Contact with electric current, unspecified	506	-	35	139	78	71	54	64	-	59
Contact with electric current of machine, tool, appliance, or light fixture	2,966	10	-	271	674	78	63	1,484	63	322
Contact with wiring, transformers, or other electrical components	1,607	31	-	568	376	183	62	-	113	236
Contact with overhead power lines	273	13	-	116	45	56	-	-	-	13
Struck by lightning	214	-	-	-	-	-	-	-	-	132
Contact with electric current, n.e.c.	415	-	-	188	99	30	-	-	-	47
Contact with temperature extremes	38,952	360	301	2,980	9,730	1,520	1,192	14,745	396	7,729
Exposure to environmental heat	2,540	108	16	451	546	224	82	175	59	878
Exposure to environmental cold	792	-	12	-	207	279	121	-	21	108
Contact with hot objects or substances ..	35,448	246	273	2,483	8,935	1,002	985	14,504	306	6,712
Contact with cold objects or substances	157	-	-	35	37	14	-	-	9	28
Exposure to air pressure changes	1,248	-	-	-	34	1,154	18	-	-	41
Pressure changes in airplane, other aircraft	1,164	-	-	-	12	1,116	18	-	-	16
Exposure to caustic, noxious, or allergenic substances	55,343	1,398	494	4,270	16,037	3,806	3,224	7,611	1,651	16,852
Exposure to caustic, noxious, or allergenic substances, unspecified	6,493	120	10	540	1,336	420	281	871	93	2,823
Inhalation of substance	12,603	181	148	611	4,033	1,164	710	1,526	441	3,789
Inhalation of substance, unspecified ...	5,728	87	111	274	2,479	379	389	529	195	1,284
Inhalation in enclosed, restricted, or confined space	2,888	27	23	146	630	371	83	217	59	1,331
Inhalation in open or nonconfined space	3,987	66	13	191	924	414	238	780	187	1,174
Contact with skin or other exposed tissue	25,380	896	227	2,275	8,569	1,224	1,483	3,776	701	6,430
Injections, stings, venomous bites	5,000	288	40	374	614	627	231	982	153	1,692
Injections, stings, venomous bites, unspecified	402	13	6	-	78	68	-	118	19	69
Needle sticks	232	15	-	-	16	-	-	-	-	186
Bee, wasp, hornet sting	2,917	177	25	233	329	440	154	561	76	921
Other stings or venomous bites	917	75	9	109	119	61	56	276	38	175
Injections, stings, venomous bites, n.e.c.	532	-	-	-	72	54	-	-	13	340
Ingestion of substance	667	25	-	-	128	102	-	-	51	260
Exposure to caustic, noxious, or allergenic substances, n.e.c.	5,200	89	68	448	1,358	269	483	418	212	1,858
Exposure to noise	282	-	-	16	44	63	-	-	-	129
Exposure to noise over time	149	-	-	-	22	-	-	-	-	91
Exposure to noise in single incident	110	-	-	-	13	-	-	-	-	34
Exposure to radiation	6,287	298	124	1,054	3,591	151	465	76	-	523
Exposure to sun	61	21	-	-	8	-	-	-	-	-
Exposure to welding light	5,984	277	124	1,020	3,430	142	448	65	-	472
Exposure to radiation, n.e.c.	184	-	-	-	118	-	-	-	-	27
Exposure to traumatic or stressful event, n.e.c.	2,021	-	-	77	579	233	97	207	368	453
Oxygen deficiency, n.e.c.	85	-	-	-	70	-	-	-	-	-
Other oxygen deficiency, n.e.c.	71	-	-	-	70	-	-	-	-	-
Exposure to harmful substances or environments, n.e.c.	421	-	-	76	202	48	-	-	-	67
Transportation incidents	79,805	2,108	626	6,224	9,487	19,841	8,478	10,252	2,382	20,428
Transportation incident, unspecified	3,217	54	11	238	199	1,162	132	554	56	811

See footnotes at end of table.

Table 14. Event or exposure and Industry division: Days-away-from-work case counts,¹ 1994 — Continued

Event	Private industry ²	Goods-producing				Service-producing				
		Agriculture, forestry, and fishing ²	Mining ³	Construction	Manufacturing	Transportation and public utilities ³	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
Highway incident	50,803	1,025	335	3,746	3,754	13,064	4,499	6,812	1,907	15,861
Highway incident, unspecified	3,524	57	74	235	258	845	190	592	198	1,075
Collision between vehicles, mobile equipment	36,009	675	248	2,581	2,435	8,080	3,390	5,348	1,299	11,953
Collision between vehicles, mobile equipment, unspecified	11,431	193	42	593	581	3,094	881	2,301	371	3,375
Re-entrant collision	149	-	-	-	15	-	-	-	14	68
Moving in same direction	8,074	57	130	595	594	1,703	888	1,080	276	2,750
Moving in opposite directions, oncoming	2,218	192	-	175	239	400	405	212	53	540
Moving in intersection	5,298	128	40	459	348	978	365	635	338	2,008
Moving and standing vehicle, mobile equipment—in roadway	5,371	60	20	515	358	1,021	454	851	196	1,896
Moving and standing vehicle, mobile equipment—side of road	658	16	-	43	130	260	-	-	-	141
Collision between vehicles, mobile equipment, n.e.c.	2,813	29	14	200	172	598	355	224	47	1,174
Vehicle struck stationary object or equipment in roadway	827	-	-	16	101	246	-	54	26	354
Vehicle struck stationary object, equipment on side of road	2,596	24	-	188	194	726	323	190	307	640
Noncollision incident	6,860	256	9	584	705	2,980	524	528	58	1,215
Noncollision incident, unspecified	215	-	-	16	17	136	-	-	-	34
Jack-knifed or overturned—no collision	2,951	123	6	297	278	1,621	219	168	13	226
Ran off highway—no collision	1,526	28	-	107	177	186	181	212	16	614
Struck by shifting load	139	-	-	-	20	86	-	-	-	-
Sudden start or stop, n.e.c.	1,168	46	-	91	140	544	76	-	19	210
Noncollision incident, n.e.c.	860	58	-	70	73	406	45	76	9	122
Highway incident, n.e.c.	987	-	-	143	60	187	48	100	17	425
Nonhighway incident, except rail, air, water	12,037	645	182	1,238	2,443	2,537	2,004	1,060	264	1,664
Nonhighway incident, unspecified	334	-	-	67	51	104	-	46	-	40
Collision between vehicles or mobile equipment	1,633	60	31	111	336	259	360	178	46	233
Vehicle, mobile equipment struck stationary object	1,884	51	-	58	550	285	436	163	63	276
Noncollision incident	7,432	515	146	974	1,310	1,701	1,024	632	147	982
Noncollision incident, unspecified	90	9	-	-	26	-	-	-	-	15
Fall from moving vehicle, mobile equipment	1,237	105	6	189	205	205	161	135	36	195
Fall from and struck by vehicle, mobile equipment	290	80	-	-	36	-	55	-	-	68
Overturned	1,859	111	123	220	250	554	182	153	19	247
Loss of control	581	28	-	62	64	244	88	-	17	71
Struck by shifting load	237	-	-	39	51	-	83	-	-	-
Sudden start or stop, n.e.c.	1,176	32	-	82	257	330	237	58	20	158
Noncollision incident, n.e.c.	1,961	150	11	363	421	340	211	203	54	208
Nonhighway incident, n.e.c.	754	19	-	-	196	189	143	-	-	133
Pedestrian, nonpassenger struck by vehicle, mobile equipment	12,022	370	84	974	2,906	1,755	1,800	1,805	150	2,177
Pedestrian struck by vehicle, mobile equipment, unspecified	2,031	67	-	216	458	260	285	166	18	561
Pedestrian struck by vehicle, mobile equipment in roadway	926	-	59	194	81	185	94	-	27	240
Pedestrian struck by vehicle, mobile equipment on side of road	365	19	21	94	97	37	-	-	22	48
Pedestrian struck by vehicle, mobile equipment in parking lot or non-roadway area	8,699	277	-	470	2,270	1,273	1,409	1,584	84	1,328
Railway incident	694	-	-	-	51	566	-	-	-	11
Railway incident, unspecified	178	-	-	-	12	168	-	-	-	-
Collision between railway vehicle and other vehicle	308	-	-	-	20	245	-	-	-	-
Derailment	57	-	-	-	-	57	-	-	-	-
Railway incident, n.e.c.	108	-	-	-	10	76	18	-	-	-
Water vehicle incident	261	-	8	-	58	139	-	-	-	41
Fall from ship, boat, n.e.c.	56	-	-	-	14	42	-	-	-	-
Fall on ship, boat	105	-	8	-	19	54	-	-	-	-
Water vehicle incident, n.e.c.	64	-	-	-	23	38	-	-	-	-
Aircraft incident	609	-	-	-	7	587	-	-	-	-

See footnotes at end of table.

Table 14. Event or exposure and industry division: Days-away-from-work case counts,¹ 1994 — Continued

Event	Private Industry ²	Goods-producing				Service-producing				
		Agriculture, forestry, and fishing ²	Mining ³	Construction	Manufacturing	Transportation and public utilities ³	Wholesale trade	Retail trade	Finance, insurance, and real estate	Services
Aircraft incident, unspecified	167	-	-	-	-	162	-	-	-	-
Aircraft incident, n.e.c.	394	-	-	-	-	381	-	-	-	-
Transportation incident, n.e.c.	164	14	-	-	49	31	-	-	-	52
Fires and explosions	5,048	140	99	762	1,180	362	266	971	71	1,197
Fire or explosion, unspecified	102	-	-	72	9	-	-	-	-	-
Fire—unintended or uncontrolled	1,866	49	46	341	595	216	159	150	32	278
Fire, unspecified	238	-	10	43	51	105	-	-	-	-
Fire in residence, building, or other structure	420	-	6	72	123	-	-	-	21	139
Forest, brush, or other outdoor fire	94	-	-	48	23	-	-	-	-	-
Ignition of clothing from controlled heat source	229	13	9	-	132	-	-	-	-	-
Fire, n.e.c.	884	30	21	167	266	67	124	89	9	111
Explosion	3,080	91	53	349	576	136	107	820	39	908
Explosion, unspecified	227	-	-	58	56	-	-	-	-	28
Explosion of battery	84	9	-	-	-	-	-	-	-	-
Explosion of pressure vessel or piping	1,087	40	45	57	175	57	76	557	10	72
Explosion, n.e.c.	1,682	43	5	222	340	43	-	192	21	800
Assaults and violent acts	26,521	1,296	46	638	1,251	1,675	758	3,592	1,121	16,143
Assaults and violent acts by person(s)	20,438	106	24	229	832	1,042	455	3,179	903	13,667
Assaults and violent acts by person(s), unspecified	2,815	67	-	-	71	329	-	892	126	1,276
Biting	543	-	-	-	-	-	-	101	-	436
Hitting, kicking, beating	8,805	26	23	177	246	284	132	1,333	319	6,264
Shooting	381	-	-	-	37	-	156	44	16	100
Squeezing, pinching, scratching, twisting	2,371	-	-	-	68	59	-	71	-	2,166
Stabbing	235	-	-	-	59	15	-	-	13	106
Threats or verbal assaults	586	-	-	-	162	38	17	-	284	52
Assaults and violent acts by person(s), n.e.c.	4,688	13	-	-	184	288	110	671	132	3,263
Self-inflicted injury	118	-	-	-	12	-	18	-	-	33
Self-inflicted injury, unspecified	70	-	-	-	6	-	-	-	-	-
Assaults by animals	5,956	1,182	22	409	404	621	286	376	214	2,442
Assaults by animals, unspecified	204	42	-	18	8	100	-	-	-	27
Nonvenomous bites	4,380	656	-	341	343	385	169	352	177	1,956
Assaults by animals, n.e.c.	1,372	485	20	50	52	137	106	-	37	459
Other events or exposures	316	-	-	22	190	15	17	9	18	43
Nonclassifiable	39,373	1,128	427	3,720	10,012	5,001	3,143	6,627	836	8,480

¹ Days-away-from-work cases include those which result in days away from work with or without restricted work activity.

² Excludes farms with fewer than 11 employees.

³ Data conforming to OSHA definitions for mining operators in coal, metal, and nonmetal mining and for employers in railroad transportation are provided to BLS by the Mine Safety and Health Administration, U.S. Department of Labor; and by the Federal Railroad Administration, U.S. Department of Transportation. Independent mining contractors are excluded from the coal, metal, and nonmetal industries.

NOTE: Dashes indicate data that are not available or data that do not meet publication guidelines. Because of rounding, data may not sum to the totals. Major classifications may include detailed classifications not shown separately. Because of space limitations, classifications for which fewer than 50 cases were reported are not included. n.e.c. = not elsewhere classified.

SOURCE: Bureau of Labor Statistics, U.S. Department of Labor.

	xviol	xstd	event	desc
1		0022	10	walking-working--gen'l req
2		0022	110	walking-working--gen'l req
3		0022	113	walking-working--gen'l req
4		0023	110	floor and wall opening
5		0023	1121	floor and wall opening
6		0023	1122	floor and wall opening
7		0023	1123	floor and wall opening
8		0023	1129	floor and wall opening
9		0024	111	fixed stairs
10		0025	113	portable wood ladders
11		0026	113	portable metal ladders
12		0027	113	fixed ladders
13		0028	116	scaffolds
14		0029	110	manually propelled towers
15		0029	113	manually propelled towers
16		0029	116	manually propelled towers
17		0029	119	manually propelled towers
18		0036	9999	egress--gen'l req
19		0037	9999	means of egress
20		0066	118	power platforms for bldg mnt.
21		0066	119	power platforms for bldg mnt.
22		0067	118	vehical mounted platforms
23		0067	119	vehical mounted platforms
24		0068	118	manlifts
25		0068	119	manlifts
26		0093	340	air contaminants
27		0093	3410	air contaminants
28		0093	3411	air contaminants
29		0093	3412	air contaminants
30		0093	342	air contaminants
31		0094	340	ventilation
32		0094	3410	ventilation
33		0094	3411	ventilation
34		0095	350	noise
35		0095	351	noise
36		0095	352	noise
37		0096	360	ionizing radiation

manstd

	xviol	xstd	event	desc
38		0096	363	ionizing radiation
39		0096	369	ionizing radiation
40		0097	360	non-ionizing radiation
41		0097	369	non-ionizing radiation
42		0101	340	compressed gas-gen'l req
43		0101	3410	compressed gas-gen'l req
44		0101	3411	compressed gas-gen'l req
45		0101	3412	compressed gas-gen'l req
46		0101	510	compressed gas-gen'l req
47		0101	511	compressed gas-gen'l req
48		0101	513	compressed gas-gen'l req
49		0101	519	compressed gas-gen'l req
50		0101	520	compressed gas-gen'l req
51		0101	522	compressed gas-gen'l req
52		0101	529	compressed gas-gen'l req
53		0102	340	acetylene compressed gas+A95
54		0102	3410	acetylene compressed gas+A95
55		0102	3411	acetylene compressed gas+A95
56		0102	3412	acetylene compressed gas+A95
57		0102	510	acetylene compressed gas+A95
58		0102	511	acetylene compressed gas+A95
59		0102	513	acetylene compressed gas+A95
60		0102	519	acetylene compressed gas+A95
61		0102	520	acetylene compressed gas+A95
62		0102	522	acetylene compressed gas+A95
63		0102	529	acetylene compressed gas+A95
64		0103	340	hydrogen compressed gas
65		0103	3410	hydrogen compressed gas
66		0103	3411	hydrogen compressed gas
67		0103	3412	hydrogen compressed gas
68		0103	510	hydrogen compressed gas
69		0103	511	hydrogen compressed gas
70		0103	513	hydrogen compressed gas
71		0103	519	hydrogen compressed gas
72		0103	520	hydrogen compressed gas
73		0103	522	hydrogen compressed gas
74		0103	529	hydrogen compressed gas

manstd

	xviol	xstd	event	desc
75		0104	340	oxygen compressed gas
76		0104	3410	oxygen compressed gas
77		0104	3411	oxygen compressed gas
78		0104	3412	oxygen compressed gas
79		0104	510	oxygen compressed gas
80		0104	511	oxygen compressed gas
81		0104	513	oxygen compressed gas
82		0104	519	oxygen compressed gas
83		0104	520	oxygen compressed gas
84		0104	522	oxygen compressed gas
85		0104	529	oxygen compressed gas
86		0105	340	nitrous oxide compressed gas
87		0105	3410	nitrous oxide compressed gas
88		0105	3411	nitrous oxide compressed gas
89		0105	3412	nitrous oxide compressed gas
90		0105	510	nitrous oxide compressed gas
91		0105	511	nitrous oxide compressed gas
92		0105	513	nitrous oxide compressed gas
93		0105	519	nitrous oxide compressed gas
94		0105	520	nitrous oxide compressed gas
95		0105	522	nitrous oxide compressed gas
96		0105	529	nitrous oxide compressed gas
97		0106	340	flammable and combustible
98		0106	3410	flammable and combustible
99		0106	3411	flammable and combustible
100		0106	3412	flammable and combustible
101		0106	510	flammable and combustible
102		0106	511	flammable and combustible
103		0106	513	flammable and combustible
104		0106	519	flammable and combustible
105		0106	520	flammable and combustible
106		0106	522	flammable and combustible
107		0106	529	flammable and combustible
108		0107	340	spray finishing using flam
109		0107	3410	spray finishing using flam
110		0107	3411	spray finishing using flam
111		0107	3412	spray finishing using flam

N-25
to be

manstd

	xviol	xstd	event	desc
112		0107	510	spray finishing using flam
113		0107	511	spray finishing using flam
114		0107	513	spray finishing using flam
115		0107	519	spray finishing using flam
116		0107	520	spray finishing using flam
117		0107	522	spray finishing using flam
118		0107	529	spray finishing using flam
119		0108	340	dip tanks with flammable
120		0108	3410	dip tanks with flammable
121		0108	3411	dip tanks with flammable
122		0108	3412	dip tanks with flammable
123		0108	510	dip tanks with flammable
124		0108	511	dip tanks with flammable
125		0108	513	dip tanks with flammable
126		0108	519	dip tanks with flammable
127		0108	520	dip tanks with flammable
128		0108	522	dip tanks with flammable
129		0108	529	dip tanks with flammable
130		0109	340	blasting agents
131		0109	3410	blasting agents
132		0109	3411	blasting agents
133		0109	3412	blasting agents
134		0109	510	blasting agents
135		0109	511	blasting agents
136		0109	513	blasting agents
137		0109	519	blasting agents
138		0109	520	blasting agents
139		0109	522	blasting agents
140		0109	529	blasting agents
141		0110	340	liquified petroleum gasses
142		0110	3410	liquified petroleum gasses
143		0110	3411	liquified petroleum gasses
144		0110	3412	liquified petroleum gasses
145		0110	510	liquified petroleum gasses
146		0110	511	liquified petroleum gasses
147		0110	513	liquified petroleum gasses
148		0110	519	liquified petroleum gasses

manstd

	xviol	xstd	event	desc
149		0110	520	liquified petroleum gasses
150		0110	522	liquified petroleum gasses
151		0110	529	liquified petroleum gasses
152		0111	340	anhydrous ammonia-storage
153		0111	3410	anhydrous ammonia-storage
154		0111	3411	anhydrous ammonia-storage
155		0111	3412	anhydrous ammonia-storage
156		0111	510	anhydrous ammonia-storage
157		0111	511	anhydrous ammonia-storage
158		0111	513	anhydrous ammonia-storage
159		0111	519	anhydrous ammonia-storage
160		0111	520	anhydrous ammonia-storage
161		0111	522	anhydrous ammonia-storage
162		0111	529	anhydrous ammonia-storage
163		0132	320	PPE-gen'l
164		0132	321	PPE-gen'l
165		0132	322	PPE-gen'l
166		0132	323	PPE-gen'l
167		0132	324	PPE-gen'l
168		0132	342	PPE-gen'l
169		0132	349	PPE-gen'l
170		0132	360	PPE-gen'l
171		0132	369	PPE-gen'l
172		0133	053	PPE--eye and face
173		0133	340	PPE--eye and face
174		0133	349	PPE--eye and face
175		0133	360	PPE--eye and face
176		0133	362	PPE--eye and face
177		0133	363	PPE--eye and face
178		0134	3410	PPE-respiratory
179		0134	3411	PPE-respiratory
180		0134	3412	PPE-respiratory
181		0134	384	PPE-respiratory
182		0134	389	PPE-respiratory
183		0135	021	PPE-head
184		0136	021	PPE-foot
185		0136	024	PPE-foot

manstd

	xviol	xstd	event	desc
186		0137	310	PPE-electrical
187		0137	011	PPE-electrical
188		0137	312	PPE-electrical
189		0137	313	PPE-electrical
190		0137	314	PPE-electrical
191		0137	319	PPE-electrical
192		0138	320	PPE-hand
193		0138	321	PPE-hand
194		0138	322	PPE-hand
195		0138	323	PPE-hand
196		0138	324	PPE-hand
197		0138	340	PPE-hand
198		0139	3410	PPE--from TB
199		0141	130	sanitation
200		0141	131	sanitation
201		0141	133	sanitation
202		0141	139	sanitation
203		0146	3411	permit-required confined space
204		0146	384	permit-required confined space
205		0146	389	permit-required confined space
206		0147	030	lock-out/tag-out
207		0147	031	lock-out/tag-out
208		0147	039	lock-out/tag-out
209		0147	310	lock-out/tag-out
210		0147	311	lock-out/tag-out
211		0147	312	lock-out/tag-out
212		0151	342	medical and first aid
213		0156	341	fire brigades
214		0156	389	fire brigades
215		0156	50	fire brigades
216		0157	341	portable extinguishers
217		0157	389	portable extinguishers
218		0157	50	portable extinguishers
219		0158	341	standpipe and hose systems
220		0158	389	standpipe and hose systems
221		0158	50	standpipe and hose systems
222		0159	341	automatic sprinklers

manstd

	xviol	xstd	event	desc
223		0159	389	automatic sprinklers
224		0159	50	automatic sprinklers
225		0160	341	fixed extinguishing system
226		0160	389	fixed extinguishing system
227		0160	50	fixed extinguishing system
228		0161	341	fixed extinguishing-dry chem
229		0161	389	fixed extinguishing-dry chem
230		0161	50	fixed extinguishing-dry chem
231		0162	341	fixed extinguishing-gas
232		0162	389	fixed extinguishing-gas
233		0162	50	fixed extinguishing-gas
234		0163	341	fixed extinguishing-spray
235		0163	389	fixed extinguishing-spray
236		0163	50	fixed extinguishing-spray
237		0164	341	fire detection system
238		0164	389	fire detection system
239		0164	50	fire detection system
240		0165	341	employee alarm system
241		0165	389	employee alarm system
242		0165	50	employee alarm system
243		0166	0220	insp of compressed gas
244		0166	50	insp of compressed gas
245		0167	0220	relief devices for comp gas
246		0167	50	relief devices for comp gas
247		0168	0220	relief devices for portable ta
248		0168	50	relief devices for portable ta
249		0169	0220	air receivers
250		0169	520	air receivers
251		0176	021	material handling-ge'l req
252		0176	130	material handling-ge'l req
253		0176	50	material handling-ge'l req
254		0176	1124	material handling-ge'l req
255		0176	445	material handling-ge'l req
256		0176	441	material handling-ge'l req
257		0177	0222	servicing wheel rims
258		0177	522	servicing wheel rims
259		0178	020	powered industrial trucks

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manstd

	xviol	xstd	event	desc
260		0178	021	powered industrial trucks
261		0178	029	powered industrial trucks
262		0178	032	powered industrial trucks
263		0178	421	powered industrial trucks
264		0178	4232	powered industrial trucks
265		0179	021	overhead and gantry cranes
266		0179	044	overhead and gantry cranes
267		0179	310	overhead and gantry cranes
268		0180	021	crawler loco. and truck cranes
269		0180	044	crawler loco. and truck cranes
270		0180	310	crawler loco. and truck cranes
271		0181	021	derricks
272		0181	044	derricks
273		0181	310	derricks
274		0183	022	helicopters
275		0183	031	helicopters
276		0183	469	helicopters
277		0184	021	slings
278		0212	0221	machinery-gen'l req
279		0212	030	machinery-gen'l req
280		0212	031	machinery-gen'l req
281		0213	0221	woodworking machinery
282		0213	030	woodworking machinery
283		0213	031	woodworking machinery
284		0213	053	woodworking machinery
285		0213	3410	woodworking machinery
286		0215	0221	abrasive wheel machinery
287		0215	030	abrasive wheel machinery
288		0215	031	abrasive wheel machinery
289		0215	053	abrasive wheel machinery
290		0215	3410	abrasive wheel machinery
291		0217	0221	mechanical power press
292		0217	030	mechanical power press
293		0217	031	mechanical power press
294		0217	053	mechanical power press
295		0217	3410	mechanical power press
296		0218	0221	forging machines

manstd

	xviol	xstd	event	desc
297		0218	030	forging machines
298		0218	031	forging machines
299		0218	053	forging machines
300		0218	3410	forging machines
301		0219	0221	mech power transmission eq
302		0219	030	mech power transmission eq
303		0219	031	mech power transmission eq
304		0219	053	mech power transmission eq
305		0219	3410	mech power transmission eq
306		0242	0221	hand & portable power tools
307		0242	0222	hand & portable power tools
308		0242	053	hand & portable power tools
309		0243	0221	hand & portable power tools
310		0243	0222	hand & portable power tools
311		0243	0230	hand & portable power tools
312		0243	0232	hand & portable power tools
313		0243	053	hand & portable power tools
314		0243	311	hand & portable power tools
315		0244	0221	hand & portable power tools
316		0244	0222	hand & portable power tools
317		0244	0230	hand & portable power tools
318		0244	0232	hand & portable power tools
319		0244	053	hand & portable power tools
320		0244	311	hand & portable power tools
321		0252	0222	welding-gen;l req
322		0252	053	welding-gen;l req
323		0252	110	welding-gen;l req
324		0252	116	welding-gen;l req
325		0252	117	welding-gen;l req
326		0252	311	welding-gen;l req
327		0252	3410	welding-gen;l req
328		0252	3411	welding-gen;l req
329		0252	360	welding-gen;l req
330		0252	362	welding-gen;l req
331		0252	363	welding-gen;l req
332		0252	50	welding-gen;l req
333		0253	0222	oxygen fuelgas welding

manstd

	xviol	xstd	event	desc
334		0253	053	oxygen fuelgas welding
335		0253	110	oxygen fuelgas welding
336		0253	116	oxygen fuelgas welding
337		0253	117	oxygen fuelgas welding
338		0253	311	oxygen fuelgas welding
339		0253	3410	oxygen fuelgas welding
340		0253	3411	oxygen fuelgas welding
341		0253	360	oxygen fuelgas welding
342		0253	362	oxygen fuelgas welding
343		0253	363	oxygen fuelgas welding
344		0253	50	oxygen fuelgas welding
345		0254	0222	arc-welding and cutting
346		0254	053	arc-welding and cutting
347		0254	110	arc-welding and cutting
348		0254	116	arc-welding and cutting
349		0254	117	arc-welding and cutting
350		0254	311	arc-welding and cutting
351		0254	3410	arc-welding and cutting
352		0254	3411	arc-welding and cutting
353		0254	360	arc-welding and cutting
354		0254	362	arc-welding and cutting
355		0254	363	arc-welding and cutting
356		0254	50	arc-welding and cutting
357		0255	0222	resistance welding
358		0255	053	resistance welding
359		0255	110	resistance welding
360		0255	116	resistance welding
361		0255	117	resistance welding
362		0255	311	resistance welding
363		0255	3410	resistance welding
364		0255	3411	resistance welding
365		0255	360	resistance welding
366		0255	362	resistance welding
367		0255	363	resistance welding
368		0255	50	resistance welding
369		0261	021	pulp, paper & paperboard mill
370		0261	030	pulp, paper & paperboard mill

manstd

	xviol	xstd	event	desc
371		0261	032	pulp, paper & paperboard mill
372		0261	039	pulp, paper & paperboard mill
373		0261	040	pulp, paper & paperboard mill
374		0261	044	pulp, paper & paperboard mill
375		0261	110	pulp, paper & paperboard mill
376		0261	310	pulp, paper & paperboard mill
377		0261	384	pulp, paper & paperboard mill
378		0261	433	pulp, paper & paperboard mill
379		0261	520	pulp, paper & paperboard mill
380		0261	3410	pulp, paper & paperboard mill
381		0262	030	textiles
382		0262	031	textiles
383		0262	340	textiles
384		0262	39	textiles
385		0263	021	bakery
386		0263	030	bakery
387		0263	130	bakery
388		0263	50	bakery
389		0264	0231	laundry machinery
390		0264	030	laundry machinery
391		0264	031	laundry machinery
392		0264	323	laundry machinery
393		0264	342	laundry machinery
394		0265	021	sawmills
395		0265	030	sawmills
396		0265	031	sawmills
397		0265	039	sawmills
398		0265	215	sawmills
399		0265	440	sawmills
400		0265	449	sawmills
401		0265	50	sawmills
402		0265	1120	sawmills
403		0265	3412	sawmills
404		0266	053	logging
405		0266	0221	logging
406		0266	0222	logging
407		0266	0230	logging

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	xviol	xstd	event	desc
408		0266	0232	logging
409		0266	313	logging
410		0266	315	logging
411		0266	322	logging
412		0266	340	logging
413		0266	520	logging
414		0268	030	telecommunications
415		0268	031	telecommunications
416		0268	053	telecommunications
417		0268	110	telecommunications
418		0268	113	telecommunications
419		0268	313	telecommunications
420		0268	314	telecommunications
421		0268	340	telecommunications
422		0268	1124	telecommunications
423		0269	020	electric power generation
424		0269	0221	electric power generation
425		0269	0222	electric power generation
426		0269	053	electric power generation
427		0269	113	electric power generation
428		0269	1124	electric power generation
429		0269	30	electric power generation
430		0269	310	electric power generation
431		0269	311	electric power generation
432		0269	312	electric power generation
433		0269	313	electric power generation
434		0269	314	electric power generation
435		0269	360	electric power generation
436		0269	384	electric power generation
437		0269	389	electric power generation
438		0269	3411	electric power generation
439		0272	030	grain handling facilities
440		0272	110	grain handling facilities
441		0272	111	grain handling facilities
442		0272	1120	grain handling facilities
443		0272	1121	grain handling facilities
444		0272	1122	grain handling facilities

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	xviol	xstd	event	desc
445		0272	1123	grain handling facilities
446		0272	1124	grain handling facilities
447		0272	1129	grain handling facilities
448		0272	113	grain handling facilities
449		0272	114	grain handling facilities
450		0272	119	grain handling facilities
451		0272	3411	grain handling facilities
452		0272	384	grain handling facilities
453		0272	520	grain handling facilities
454		0303	310	electrical--gen'l req
455		0303	311	electrical--gen'l req
456		0303	312	electrical--gen'l req
457		0303	313	electrical--gen'l req
458		0303	314	electrical--gen'l req
459		0303	319	electrical--gen'l req
460		0303	510	electrical--gen'l req
461		0304	310	electrical-wiring design
462		0304	311	electrical-wiring design
463		0304	312	electrical-wiring design
464		0304	313	electrical-wiring design
465		0304	314	electrical-wiring design
466		0304	319	electrical-wiring design
467		0304	510	electrical-wiring design
468		0305	310	elec wiring methods
469		0305	311	elec wiring methods
470		0305	312	elec wiring methods
471		0305	313	elec wiring methods
472		0305	314	elec wiring methods
473		0305	319	elec wiring methods
474		0305	510	elec wiring methods
475		0306	310	elec specific purpose equip
476		0306	311	elec specific purpose equip
477		0306	312	elec specific purpose equip
478		0306	313	elec specific purpose equip
479		0306	314	elec specific purpose equip
480		0306	319	elec specific purpose equip
481		0306	510	elec specific purpose equip

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	xviol	xstd	event	desc
482		0307	310	elec-hazardous locations
483		0307	311	elec-hazardous locations
484		0307	312	elec-hazardous locations
485		0307	313	elec-hazardous locations
486		0307	314	elec-hazardous locations
487		0307	319	elec-hazardous locations
488		0307	510	elec-hazardous locations
489		0308	310	elec--special systems
490		0308	311	elec--special systems
491		0308	312	elec--special systems
492		0308	313	elec--special systems
493		0308	314	elec--special systems
494		0308	319	elec--special systems
495		0308	510	elec--special systems
496		0333	310	elec-work practices
497		0333	311	elec-work practices
498		0333	312	elec-work practices
499		0333	313	elec-work practices
500		0333	314	elec-work practices
501		0333	319	elec-work practices
502		0333	510	elec-work practices
503		0334	310	elect--use of equipment
504		0334	311	elect--use of equipment
505		0334	312	elect--use of equipment
506		0334	313	elect--use of equipment
507		0334	314	elect--use of equipment
508		0334	319	elect--use of equipment
509		0334	510	elect--use of equipment
510		0335	310	elec-safe personal protection
511		0335	311	elec-safe personal protection
512		0335	312	elec-safe personal protection
513		0335	313	elec-safe personal protection
514		0335	314	elec-safe personal protection
515		0335	319	elec-safe personal protection
516		0335	510	elec-safe personal protection

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Descriptive Statistics

Appendix IV

	N	Minimum	Maximum	Mean	Std. Deviation
NINSP90	16036	.00	21.00	.1801	.6199
NINSP91	16036	.00	40.00	.1946	.6722
NINSP92	16036	.00	21.00	.1742	.5594
NINSP93	16036	.00	13.00	.1633	.5270
NINSP94	16036	.00	18.00	.1744	.5379
NINSP95	16036	.00	15.00	.1542	.5046
NINSP96	16036	.00	10.00	.1400	.4652
NINSP97	16036	.00	12.00	.1485	.4884
NINSP98	16036	.00	13.00	.1477	.5092
NIPEN90	16036	.00	7.00	8.861E-02	.3545
NIPEN91	16036	.00	5.00	9.928E-02	.3584
NIPEN92	16036	.00	5.00	9.697E-02	.3471
NIPEN93	16036	.00	6.00	9.572E-02	.3493
NIPEN94	16036	.00	11.00	.1076	.3887
NIPEN95	16036	.00	8.00	8.275E-02	.3290
NIPEN96	16036	.00	5.00	7.109E-02	.2994
NIPEN97	16036	.00	6.00	7.564E-02	.3122
NIPEN98	16036	.00	5.00	8.094E-02	.3348
INSP90	16036	.00	1.00	.1230	.3284
INSP91	16036	.00	1.00	.1332	.3398
INSP92	16036	.00	1.00	.1262	.3321
INSP93	16036	.00	1.00	.1217	.3270
INSP94	16036	.00	1.00	.1308	.3372
INSP95	16036	.00	1.00	.1173	.3218
INSP96	16036	.00	1.00	.1078	.3102
INSP97	16036	.00	1.00	.1132	.3169
INSP98	16036	.00	1.00	.1075	.3098
IPIEN90	16036	.00	1.00	7.234E-02	.2591
IPIEN91	16036	.00	1.00	8.331E-02	.2764
IPIEN92	16036	.00	1.00	8.300E-02	.2759
IPIEN93	16036	.00	1.00	8.144E-02	.2735
IPIEN94	16036	.00	1.00	8.905E-02	.2848
IPIEN95	16036	.00	1.00	7.084E-02	.2566
IPIEN96	16036	.00	1.00	6.180E-02	.2408
IPIEN97	16036	.00	1.00	6.529E-02	.2470
IPIEN98	16036	.00	1.00	6.579E-02	.2479
EMPIN90	16036	.00	787000.00	220.1283	6462.3293
EMPIN91	16036	.00	1381351.0	265.2133	11032.8273
EMPIN92	16036	.00	483765.00	185.7531	4092.9274
EMPIN93	16036	.00	159130.00	153.3742	1951.5270
EMPIN94	16036	.00	135000.00	150.1713	1690.5037
EMPIN95	16036	.00	129165.00	129.3949	1425.4529
EMPIN96	16036	.00	86094.00	114.9988	1236.4858
EMPIN97	16036	.00	53040.00	125.7625	1209.3734
EMPIN98	16036	.00	93300.00	136.4895	1553.7358
EMPC90	16036	.00	285169.00	69.7862	2293.5994
EMPC91	16036	.00	26500.00	57.7274	473.6353
EMPC92	16036	.00	142790.00	58.6209	1236.7087
EMPC93	16036	.00	40300.00	45.8859	411.8711
EMPC94	16036	.00	30000.00	46.5012	367.2239
EMPC95	16036	.00	16357.00	41.2134	283.9733
EMPC96	16036	.00	31412.00	36.3312	347.5117
EMPC97	16036	.00	32475.00	41.7465	428.1872
EMPC98	16036	.00	40476.00	49.2627	471.2077
EMPT90	16036	.00	1200000.0	2769.5513	32578.8716
EMPT91	16036	.00	1590000.0	2979.5567	38043.1207

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EMPT92	16036	.00	2000000.0	2418.7208	35264.4933
EMPT93	16036	.00	1900000.0	2127.8948	29754.0837
EMPT94	16036	.00	1800000.0	2317.2992	32398.1372
EMPT95	16036	.00	1510000.0	2176.2338	31956.7339
EMPT96	16036	.00	600000.00	1362.6497	16076.6418
EMPT97	16036	.00	900000.00	1726.0915	20010.3718
EMPT98	16036	.00	1200000.0	1816.8717	23560.2760
IN-HRS90	16036	.00	50730.00	79.3626	702.6518
IN-HRS91	16036	.00	70010.00	91.8649	961.8203
IN-HRS92	16036	.00	24860.00	71.8849	446.9568
IN-HRS93	16036	.00	48280.00	71.7748	632.0801
IN-HRS94	16036	.00	14955.00	69.5662	387.3913
IN-HRS95	16036	.00	24310.00	64.0733	451.4862
IN-HRS96	16036	.00	29445.00	64.3907	453.4587
IN-HRS97	16036	.00	60309.00	68.1583	657.4833
IN-HRS98	16036	.00	81490.00	78.2419	807.4634
PE.N90	16036	.00	1536250.0	373.0269	13945.0988
PE.N91	16036	.00	5800000.0	977.5865	48998.1067
PE.N92	16036	.00	281400.00	522.3699	5090.6769
PE.N93	16036	.00	7538500.0	925.9853	59870.7593
PE.N94	16036	.00	712250.00	593.5306	8099.0079
PE.N95	16036	.00	1000000.0	454.3026	9847.4854
PE.N96	16036	.00	608000.00	371.8661	6693.5789
PE.N97	16036	.00	465810.00	441.8685	6497.2572
PE.N98	16036	.00	724000.00	610.6815	11225.2481
VIDO90	16036	.00	332.00	.9092	6.4670
VIDO91	16036	.00	337.00	.9015	5.5773
VIDO92	16036	.00	124.00	.7785	3.9714
VIDO93	16036	.00	144.00	.7055	3.6705
VIDO94	16036	.00	120.00	.7608	3.6967
VIDO95	16036	.00	124.00	.5718	3.2303
VIDO96	16036	.00	140.00	.4996	3.0754
VIDO97	16036	.00	151.00	.4857	3.0824
VIDO98	16036	.00	89.00	.5176	3.0061
SER90	16036	.00	295.00	.4495	4.3654
SER91	16036	.00	299.00	.4504	4.0962
SER92	16036	.00	83.00	.4080	2.4603
SER93	16036	.00	128.00	.3640	2.3695
SER94	16036	.00	58.00	.3997	2.0630
SER95	16036	.00	96.00	.2803	1.9111
SER96	16036	.00	69.00	.2378	1.5875
SER97	16036	.00	92.00	.2560	1.8839
SER98	16036	.00	86.00	.2748	1.8484
VIOS90	16036	.00	237.00	1.0072	5.9291
VIOS91	16036	.00	255.00	1.0483	5.6902
VIOS92	16036	.00	151.00	.9386	4.7951
VIOS93	16036	.00	168.00	.8782	4.5052
VIOS94	16036	.00	121.00	.9517	4.6493
VIOS95	16036	.00	150.00	.7148	4.1190
VIOS96	16036	.00	142.00	.6185	3.7578
VIOS97	16036	.00	175.00	.6179	3.8554
VIOS98	16036	.00	142.00	.6819	4.0639
CONT90	16036	.00	7.00	1.783E-02	.1735
CONT91	16036	.00	4.00	2.189E-02	.1754
CONT92	16036	.00	6.00	2.457E-02	.1856
CONT93	16036	.00	7.00	2.270E-02	.1790

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CDNT94	16036	.00	4.00	2.357E-02	.1834
CDNT95	16036	.00	5.00	1.952E-02	.1635
CDNT96	16036	.00	3.00	1.628E-02	.1436
CDNT97	16036	.00	7.00	1.771E-02	.1616
CDNT98	16036	.00	7.00	1.783E-02	.1639
DEN90	16036	.00	1.00	1.434E-03	3.785E-02
DEN91	16036	.00	3.00	1.871E-03	4.864E-02
DEN92	16036	.00	2.00	1.746E-03	4.464E-02
DEN93	16036	.00	2.00	1.122E-03	3.530E-02
DEN94	16036	.00	1.00	1.434E-03	3.785E-02
DEN95	16036	.00	1.00	1.060E-03	3.254E-02
DEN96	16036	.00	2.00	1.060E-03	3.441E-02
DEN97	16036	.00	3.00	1.247E-03	4.025E-02
DEN98	16036	.00	2.00	1.185E-03	3.785E-02
SAF90	16036	.00	18.00	.1125	.4547
SAF91	16036	.00	33.00	.1263	.5198
SAF92	16036	.00	18.00	.1115	.4316
SAF93	16036	.00	9.00	.1023	.3800
SAF94	16036	.00	10.00	.1072	.3840
SAF95	16036	.00	12.00	9.535E-02	.3725
SAF96	16036	.00	7.00	8.662E-02	.3399
SAF97	16036	.00	9.00	9.055E-02	.3541
SAF98	16036	.00	11.00	8.999E-02	.3533
FSAF90	16036	.00	4.00	4.858E-02	.2268
FSAF91	16036	.00	6.00	5.637E-02	.2461
FSAF92	16036	.00	3.00	4.864E-02	.2214
FSAF93	16036	.00	4.00	4.702E-02	.2178
FSAF94	16036	.00	3.00	4.590E-02	.2169
FSAF95	16036	.00	9.00	4.122E-02	.2157
FSAF96	16036	.00	5.00	3.742E-02	.2016
FSAF97	16036	.00	3.00	3.548E-02	.1923
FSAF98	16036	.00	5.00	3.530E-02	.1921
WALK90	16036	.00	21.00	7.913E-02	.4407
WALK91	16036	.00	35.00	8.069E-02	.4802
WALK92	16036	.00	17.00	7.396E-02	.3877
WALK93	16036	.00	13.00	6.928E-02	.3684
WALK94	16036	.00	18.00	7.751E-02	.3903
WALK95	16036	.00	10.00	7.589E-02	.3600
WALK96	16036	.00	8.00	6.997E-02	.3381
WALK97	16036	.00	10.00	7.377E-02	.3587
WALK98	16036	.00	12.00	7.477E-02	.3724
TALK90	16036	.00	18.00	8.119E-02	.3983
TALK91	16036	.00	25.00	9.660E-02	.4608
TALK92	16036	.00	18.00	8.468E-02	.3910
TALK93	16036	.00	7.00	8.269E-02	.3626
TALK94	16036	.00	17.00	9.223E-02	.3969
TALK95	16036	.00	12.00	8.911E-02	.3852
TALK96	16036	.00	10.00	7.957E-02	.3525
TALK97	16036	.00	12.00	8.163E-02	.3669
TALK98	16036	.00	13.00	7.776E-02	.3697
UNION90	16036	.00	21.00	9.921E-02	.5293
UNION91	16036	.00	38.00	.1050	.5663
UNION92	16036	.00	21.00	8.905E-02	.4543
UNION93	16036	.00	13.00	8.051E-02	.4227
UNION94	16036	.00	18.00	8.550E-02	.4216
UNION95	16036	.00	15.00	7.514E-02	.3971

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
UNION96	16036	.00	10.00	6.672E-02	.3536
UNION97	16036	.00	12.00	7.134E-02	.3793
UNION98	16036	.00	13.00	7.277E-02	.3988
FULL90	16036	.00	5.00	6.174E-02	.2663
FULL91	16036	.00	6.00	6.928E-02	.2839
FULL92	16036	.00	4.00	6.280E-02	.2616
FULL93	16036	.00	4.00	6.186E-02	.2627
FULL94	16036	.00	5.00	6.261E-02	.2651
FULL95	16036	.00	9.00	5.556E-02	.2558
FULL96	16036	.00	10.00	5.201E-02	.2543
FULL97	16036	.00	4.00	4.983E-02	.2379
FULL98	16036	.00	5.00	5.319E-02	.2712
PLAN90	16036	.00	4.00	4.727E-02	.2239
PLAN91	16036	.00	6.00	4.895E-02	.2319
PLAN92	16036	.00	4.00	4.546E-02	.2174
PLAN93	16036	.00	4.00	4.596E-02	.2218
PLAN94	16036	.00	4.00	5.014E-02	.2332
PLAN95	16036	.00	3.00	4.733E-02	.2252
PLAN96	16036	.00	5.00	4.571E-02	.2296
PLAN97	16036	.00	4.00	4.926E-02	.2378
PLAN98	16036	.00	5.00	5.145E-02	.2665
COMP90	16036	.00	13.00	7.801E-02	.3865
COMP91	16036	.00	18.00	8.637E-02	.3943
COMP92	16036	.00	13.00	7.514E-02	.3640
COMP93	16036	.00	13.00	7.296E-02	.3513
COMP94	16036	.00	13.00	7.433E-02	.3418
COMP95	16036	.00	9.00	6.654E-02	.3273
COMP96	16036	.00	9.00	5.930E-02	.3033
COMP97	16036	.00	10.00	6.223E-02	.3178
COMP98	16036	.00	10.00	5.806E-02	.3112
REFER90	16036	.00	3.00	1.434E-02	.1314
REFER91	16036	.00	4.00	1.397E-02	.1309
REFER92	16036	.00	2.00	1.359E-02	.1195
REFER93	16036	.00	4.00	1.010E-02	.1090
REFER94	16036	.00	3.00	1.266E-02	.1204
REFER95	16036	.00	2.00	1.023E-02	.1037
REFER96	16036	.00	3.00	8.793E-03	.1004
REFER97	16036	.00	3.00	1.098E-02	.1145
REFER98	16036	.00	3.00	1.235E-02	.1196
STATE	16036	1.00	56.00	27.9985	16.0118
BASIC	16036	2011.00	3999.00	3042.7953	588.7837
INJ92	10138	.00	6235.00	23.2330	89.5596
ILL92	10138	.00	1275.00	5.3226	28.7754
EMP92	10138	1.00	99840.00	514.3929	1432.3302
HOURS92	10138	150.00	1.91E+08	1016626.5	2796908.3841
LWDI92	10138	.00	229.80	5.7026	7.1323
LWDII92	10138	.00	229.80	6.3853	7.7310
INJ93	12673	.00	5365.00	21.8653	78.1730
ILL93	12673	.00	1144.00	5.0907	27.3151
EMP93	12673	1.00	94199.00	485.3093	1312.8209
HOURS93	12673	300.00	1.83E+08	971197.92	2594843.1220
LWDI93	12673	.00	448.62	5.3708	7.0340
LWDII93	12673	.00	953.32	6.0720	10.5980
INJ94	14236	.00	4226.00	21.2808	69.9501
ILL94	14236	.00	1161.00	5.2816	28.5502
EMP94	14236	1.00	82593.00	464.4491	1185.1431



Memorandum

Date: March 18, 2003

From: Lee M. Sanderson, Ph.D., Program Official *Lee M Sanderson*
Office of Extramural Programs, NIOSH, E-74

Subject: Final Report Submitted for Entry into NTIS for Grant 5 R01 OH003895-03.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment

cc: Sherri Diana, EID, P03/C13

List of Publications

NIOSH Closeout Summary with Publications

Title: The Impact of OSHA Inspections on Manufacturing Injuries
Investigator: John M. Mendeloff, Ph.D.
Affiliation: University of Pittsburgh
City & State: Pittsburgh, PA
Telephone: (412) 648-2651
Award Number: 5 R01 OH003895-03
Start & End Date: 9/30/1999–9/29/2001
Total Project Cost: \$239,123
Program Area: Intervention Effectiveness Research Methods
Key Words:

Final Report Abstract:

This study examines the injury prevention impact of OSHA inspections at manufacturing plants from 1992 to 1998. The data come from matching establishments in the OSHA IMIS and the BLS Survey of Occupational Injuries and Illnesses. We matched 16,036 establishments and obtained a sample of 50,076 observations of annual changes in injuries. The study carries out 3 main sets of analyses. The first compares outcomes in 1992-98 with those from very similar studies that examined 2 earlier periods: 1979-85 and 1987-91. The second examines how the characteristics of workplaces and inspections affected the impact of inspections in the 1992-98 period. The third disaggregates both interventions and outcomes to examine how both inspections and the citation of particular violations affected particular injury event types.

The comparison across periods found that the sizable effects of inspections found in 1979-85 had declined steadily over time. Depending on what model was used, the reduction in lost workday (LWD) injuries from an inspection with a penalty was either 15% in the first period, 8% in the second period, and 1 % in the most recent period; or 22% in the first period, 15% in the second period, and 8% in the most recent period. These reductions were seen across all size classes of establishments and across all inspection types. We also looked separately at the two components of the LWD rate: injuries with days away from work (DAW) and injuries with restricted work activity only (RWA). In all 3 periods we found that inspections had had no impact on RWA injuries and thus that all of the decline in effectiveness had occurred among DAW injuries. We examined several candidates for explaining the declining impact, but were not able to arrive at a satisfactory explanation.

Our study of the 1992-98 period showed that the only clear evidence of effectiveness occurred among establishments with fewer than 100 workers. Inspections at unionized workplaces were found to lead to increases in the numbers of RWA injuries, probably because of changes in management practices that the inspections induce. Surprisingly, health inspections led to sizable reductions in injuries while safety inspections did not. Complaint inspections showed more evidence of impact than programmed inspections, but we found no robust evidence that inspections in particular industries were particularly effective.

NIOSH Closeout Summary with Publications

The third set first categorized DAW injury events into those that were more or less preventable through enforcement of OSHA standards. Contrary to expectations, we found that injury types not addressed by standards were reduced by inspections more than those that were; for example, injuries due to "bodily reaction and exertion" were affected by inspections, but injuries due to getting caught in machinery were not. We also looked at the effects of citing 5 frequently violated standards. Among them, only citations of the general personal protective equipment standard led regularly to injury reductions. We concluded that OSHA inspections have effects not only through a detection/correction mechanism, but also through inducing employers to pay more attention to safety problems as a whole.

Publications

No publications to date.