Testimony of
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The George Washington University

Hearing Before the
House Education and the Workforce Committee, Subcommittee on Workforce Protections
United States House of Representatives

A More Effective and Collaborative OSHA: A View from Stakeholders

February 27, 2018

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Chairman Byrne, Ranking Member Takano and Members of the Subcommittee, thank you for inviting me. My name is David Michaels. I am an epidemiologist and Professor of Environmental and Occupational Health at the Milken Institute School of Public Health of George Washington University. The views expressed in my testimony are my own and do not represent the views of George Washington University.

From 2009 until January 2017, I served as Assistant Secretary of Labor for Occupational Safety and Health, the longest serving Assistant Secretary in OSHA's history. From 1998 to 2001, I was Assistant Secretary for Environment, Safety and Health in the U.S. Department of Energy, charged with protecting the workers, community residents and environment in and around the nation's nuclear weapons facilities.

Almost fifty years ago, Congress passed the Occupational Safety and Health Act, giving workers the right to a safe workplace and requiring employers to provide workers with a workplace free of recognized serious hazards. With that law, Congress created the Occupational Safety and Health Administration to enforce that law, to make sure that workers are not killed or injured or made sick because of their work.

The OSHAct established standard setting and enforcement as the twin foundations of OSHA. These two tools are to be supplemented by compliance assistance, outreach, and other activities. And there is compelling evidence that this formula works -- that both strong standards and OSHA inspections are effective in preventing work injuries. I will explain why in my testimony.

OSHA's compliance assistance programs are useful for those employers who voluntarily want to protect their employees and for employees who want to know what hazards they face and their rights under the law, but for many reasons, these programs are far less effective than, and are not a substitute for protective standards and strong, fair enforcement

Over these almost five decades, great progress has been made in protecting the safety and health of workers in the United States. It is not hyperbole to use the word "carnage" to describe the hazardous conditions in the American workplace before OSHA. In any year, more workers were killed on the job than US soldiers were killed on the battlefield in Vietnam. In 1970, an estimated 14,000 workers were killed on the job, an annual rate of 18 per 100,000 or about 38 workers killed on the job every day.

Today, thanks to the efforts of OSHA, employers, workers and their representatives and safety and health professionals, the situation is much improved. The fatal injury rate is 3.6 per 100,000; with a workforce almost twice as large as that of 1970. But this translates to more than 14 workplace deaths every day. The Bureau of Labor Statistics recently reported that 5,190 fatal work injuries died on the job in 2016, a seven percent increase from the 4,836 fatal injuries reported in 2015 and the third year in a row the number has increased.[1] Tens of thousands die of occupational disease every year and over three million suffer serious injuries.[*]

[*] This is likely a significant undercount because, although statistics on fatal injury statistic are considered to be reasonably accurate and complete, it is widely recognized that this is not the case for non-fatal work-related injuries.

While the OSHA budget hovers year after year at around $550 million, that number is dwarfed by the enormous cost of workplace injury, illness and death: one study estimated the annual cost of occupational injuries, illnesses, and deaths in the United States at $250 billion (in 2007 dollars), which is more than the $219 billion for cancer and more than half of the $431.8 billion for cardiovascular disease.[2]

The primary challenge I faced as Assistant Secretary and that OSHA faces today is how to ensure that employers provide safe workplaces and prevent as many injuries and illnesses as possible, and doing this with astonishingly meager – and shrinking -- resources given the size and scope of workplace injury and illness that still exist in this country.

As Assistant Secretary, I had to examine and evaluate the tools Congress gave OSHA. There is no question that standards are OSHA's most effective and efficient tool to save lives because standards improve workplace practices and conditions in the largest number of workplaces. Much of the progress OSHA has made is in reducing hazards, and saving lives, in the areas where it has issued standards. Most employers are law abiding and will comply with OSHA standards; even without an inspection, they attempt to follow the law and protect their workers from the hazards addressed by the standard.

Standards

In Washington DC these days, many politicians rarely use the word "regulation" without prefacing it with words like "job-killing" and "burdensome." This sentiment is deeply erroneous. First, it is more accurate to call OSHA standards public health "protections" because that's exactly what they do: protect workers from preventable injuries, illnesses and death. When you hear someone talk about rolling back OSHA regulations, they're really talking about endangering workers.

The evidence for the life-saving effects of OSHA standards is compelling and impressive: Asbestos exposure in US workplaces, once common-place, is now largely controlled. After the OSHA bloodborne pathogens standard, the rate of new hepatitis B cases in healthcare workers dropped dramatically to almost zero today. Grain explosions used to be regular occurrences; the OSHA standard has made them relatively rare. I could go on and on describing how every OSHA standard has saved lives and protected workers' health.

Second, while there is powerful evidence that OSHA standards save lives, there is no evidence that OSHA standards kill jobs. Not only are OSHA standards not "job killers", once implemented, their economic costs have been shown to be far lower than employer groups predicted in the rule-making process. In fact, they are generally lower than even OSHA

Following a series of studies showing that employer logs did not contain a substantial portion of workplace injuries reported elsewhere (among, for example, those reported to workers' compensation carriers or through emergency department visits), BLS estimates the Survey of Occupational Injuries and Illnesses (SOII) collects between 40% and 70% of workplace injuries. (see Wiatrowski WJ. Examining the Completeness of Occupational Injuries and Illnesses. Monthly Labor Review June 2014 1-12. Available at: https://www.bls.gov/opub/mlr/2014/article/pdf/examining-the-completeness-of-occupational-injury-and-illness-data-an-update-on-current-research.pdf

estimated, because new standards drive technological change that make implementation of these standards significantly less costly than even OSHA could have foreseen.[3]

Here is the truth: OSHA standards don't kill jobs. They stop jobs from killing workers.

After almost 20 years of work, OSHA issued a silica standard in 2016. This new rule will prevent hundreds of cases of silicosis and lung cancer each year. Employers in the construction industry now recognize that they must control silica dust and by all reports employers are now purchasing equipment with vacuum or wetting attachments that the standard requires to protect workers. The costs of this equipment are small, especially in comparison to the human and economic costs of a case of lung cancer or silicosis. Because most employers want to follow the law, simply by issuing this standard OSHA will save thousands of lives.

There are other important examples of OSHA standards that protect workers and save lives, but sadly not enough. This is because standard setting takes far too long. The GAO estimated that it takes an average of seven years for OSHA to issue one major standard,[4] and I believe that's an underestimate. For example, OSHA began working on the beryllium standard almost 20 years before finally issuing it in 2017. The new standard protecting workers from respirable crystalline silica took equally long. Standard setting is also resource-intensive, and some administrations simply neglect their duty to protect workers and stop issuing new standards. This is what the current Administration is doing – by stopping efforts to protect workers through issuing new standards and by attempting to roll back existing protections.

Even more problematic for workers and employers who recognize the need for standards, President Trump has issued an Executive Order requiring agencies to rescind two regulations for every one added.[5] There is no legal basis -- and certainly no moral basis -- for removing two worker protections for every one added. If OSHA issues a standard to protect tree-care workers, will they have to eliminate protections for workers in trenches or workers exposed to asbestos?

There are thousands of chemicals in use in the nation's workplaces; OSHA has standards for only about 500 of them and 95% of those standards date to the 1960s or earlier. Despite the image that many like to give OSHA as a machine that churns out regulation after regulation, the agency has been able to update or issue new standards for only about 30 chemicals in 50 years.

One example of the many hazardous chemicals for which OSHA does not have a standard is 1-bromopropane, a chemical that has severe neurological effects, rendering exposed workers unable to walk or maintain their balance.[6] In addition, the chemical and is categorized by the National Toxicology Program as "reasonably anticipated to be a human carcinogen."

To address this, OSHA started the process of issuing a standard for 1-bromopropane. It is astounding to me that the Department of Labor has simply terminated that effort, with no further discussion of how it plans to protect workers from this chemical.

Similarly, OSHA has no standards, or weak, outdated ones in important safety areas as well, and the Department of Labor is ending efforts to address these gaps as well:

- The explosion and fire at West Fertilizer in West, Texas and other chemical facilities in recent years illuminated many of the holes in the Process Safety Management Standard. It is listed as on long-term action on the Regulatory Agenda and to date, we have heard nothing from OSHA that would indicate that this important standard is moving forward.

- Each year, thousands of workers in healthcare and social services are victims of workplace violence – California has a standard protecting health care workers from workplace violence, but OSHA has none. Before I left OSHA, we announced we were starting work on a standard. Despite the fact that there has been a one-day stakeholder meeting and a very active Request for Information (RFI), OSHA has yet to announce a date for the small business review (or SBREFA) process – the first major step of rulemaking, and no SBREFA is scheduled for FY 2019 according to the Congressional Budget justification. This important standard, one that could save thousands of our front-line health care workers from serious injury, has apparently been put on the backburner.
- Similarly, no action is scheduled for OSHA's infectious disease standard. In an age where we've already seen Ebola cases in the United States, where rare and deadly diseases can travel across continents in a matter of hours, our front-line health care workers remain vulnerable to all but bloodborne pathogens, a standard that was issued almost 30 years ago.
- The only major new standard that OSHA seems to be moving forward on at present is one to protect cell tower workers. While this is welcomed, OSHA meanwhile has taken standards off the regulatory agenda that would have protected workers who are crushed to death by construction vehicles; workers exposed to 1-bromopropane or styrene; and, years after the devastating explosion at Imperial Sugar that killed 14 workers and injured 39 more, OSHA has taken the combustible dust standard off of the agenda.

There is much talk today of the costs of regulations to employers. Forgotten in this conversation is the cost to workers and their families of *not* creating these protections. These costs are enormous, and they are paid not just in dollars. They are paid in lives.

Instead of working on new protections for workers, OSHA's leadership seems to be more concerned about putting resources into weakening current worker protections. After many years of work, and eighteen years after the Department of Energy updated its workplace beryllium exposure standard, OSHA finally issued its own beryllium regulation in 2017, updating an antiquated and inadequately protective standard. Under the Trump Administration, the agency has now issued a proposal to weaken beryllium protections for construction and maritime workers, not because this standard would threaten either industry, and not because any new evidence has surfaced that the protections are not needed, but solely as a result of intensive lobbying from coal slag producers whose business is threatened by the standard.

OSHA is also considering weakening the electronic recordkeeping rule that holds promise to provide valuable information that OSHA and employers can use to improve health and safety conditions for working people.

Enforcement of OSHA Standards

Enforcement is OSHA's other fundamental tool. While many employers will comply with OSHA standards even if no OSHA inspector shows up at their door, there are far too many employers who cut corners on safety in this country, and far too many workers who never come home.

Study after study have shown that OSHA inspections (and, particularly, inspections with penalties) prevent injuries in the years after the inspection occurs. One study, conducted by

Business School faculty from Harvard and the University of California Berkeley and published in the prestigious journal Science, found that establishments subject to random OSHA inspections showed a 9.4 percent decrease in injury rates compared with uninspected firms. The study also found no evidence of any cost to inspected companies complying with regulations. In fact, the decrease in injuries led to a 26 percent reduction in costs from medical expenses and lost wages. This translates to an average of $350,000 per company, showing that OSHA regulations actually save businesses money.[7]

This study, along with a Commentary[8] I wrote for the American Journal of Industrial Medicine that describes the study published in Science and two other studies that show similar results,[9,10] are attached to this testimony.

OSHA's ability to conduct those injury-preventing inspections is limited by its meager budget and small inspectorate. OSHA and its state plan partners are responsible for the health and safety of worker in 8 million workplaces in this country, but the agency has only enough inspectors to visit every workplace one every 159 years.[11] What this means is that unless an employee is hospitalized or killed in the workplace, the vast majority of employers in this country – even in high hazard workplaces – are not likely to ever see an OSHA inspector.

I was happy to see that the administration proposed a small increase in OSHA's enforcement budget for next year, but even this modest increase will not bring staffing levels up to those of 2010, when after years of erosion, were restored to FY 2001 levels. Further cuts in enforcement, as the House proposed for FY 2018, would have devastating effects for workers' lives and health.

And also remember that federal OSHA enforces the law in only 29 states. No increase has been proposed for the state plan states that enforce OSHA standards in the other 21 states. In fact, the state plans have not had a budget increase in eight years, and their budget is actually lower today than it was in 2010.

But even with this proposed budget, OSHA has a lot of catching up to do. The hiring freeze that was only recently lifted for Compliance Safety and Health Officers--and remains for all other employees - has had a devastating effect on OSHA's enforcement program. In one state, Mississippi, statistically one of the most dangerous states in the country, inspections fell by almost 25% last year because of empty inspector positions that were not filled.

And the hiring freeze has still not been lifted for other OSHA staff – managers, administrative staff and whistleblower investigators for example. Fewer managers and administrative support means it takes longer for cases to get done. And the longer it takes for a case to be finalized, the longer workers are exposed to hazards.

Recognizing that we did not have the resources to conduct many more inspections, during the Obama Administration we made great efforts to increase the impact of inspections – so that non-inspected employers would voluntarily abate hazards without OSHA having to inspect. Unfortunately, the Trump Administration's Department of Labor is attempting to reverse many of these efforts and their reversal will undoubtedly result in more workers being injured and killed.

We focused most of OSHA's enforcement activities on the worksites where workers were most at risk. These local or national emphasis programs targeted a specific industry or hazard where higher injury and illness rates, and other problems had been documented. OSHA developed new emphasis programs in numerous high risk industries, including grain handling, auto parts and poultry industry. Meat and poultry workers, for example, have among the highest injury rates of any industry, and even those numbers are underreported.

Poultry was one area on which we put special attention because of the high amputation rates and other serious problems like employers failing to allow workers on the poultry processing line to use the bathroom. You can imagine how shocked I was recently to learn that OSHA had rejected recommendations from the Government Accountability Office (GAO) that the agency "consider off-site interviews or exploring other options to obtain information anonymously," and that OSHA inspectors make a greater effort to ask poultry workers about the extent to which bathroom access is a problem.[12] These recommendations were designed to address findings from its investigation that poultry workers are intimidated about reporting health and safety problems to OSHA, particularly about their inability to get bathroom breaks. What possible reason OSHA had to reject these common-sense recommendations I can't imagine.

And let me clarify again. OSHA enforcement does not just "react" to workers who have already been injured or killed. In fact, most OSHA inspections are conducted before workers are injured or killed. The main benefit of OSHA inspections is that by demonstrating that OSHA is on the job, ensuring that employers comply with the law, they prevent further injuries and illnesses.

A third area we used to leverage enforcement resources was the use of Enforcement Units (EUs), a weighting system that gives area offices greater credit for more complex, impactful inspections. Before implementing this system, every inspection, no matter how lengthy or complex, was counted the same - one inspection toward meeting an office's target. Some offices focused on quick inspections to meet their target. Now inspectors get more credit for inspections involving, among other things, measuring for chemical exposure, ergonomic hazards, PSM, or workplace violence, all of which are time consuming.

Currently, OSHA is moving toward counting Compliance Assistance Outreach as part of the EU system, which would result in the system no longer providing a weighted measure of enforcement activities. Compliance assistance, as discussed below, is an important OSHA function, but it is conducted by different staff and funded under a different budget line than enforcement. Merging the two appears to be a non-transparent mechanism to shift resources from enforcement to compliance assistance.

A fourth strategy we utilized to enhance the impact of enforcement was to publicize significant enforcement cases. Previous administrations issued press releases for every enforcement case that had penalties greater than $70,000. We reduced that threshold to inspections with fines above $40,000, theorizing that reminding employers in the same geographic area or in the same industry that OSHA is on the job, and is issuing penalties will be an important additional incentive to encourage employers to abate hazards, even in workplaces that OSHA is unable to inspect.

A recently completed study supports our theory. Duke University economist Dr. Matthew Johnson completed a study that found that "publicizing the violations of one facility leads geographically proximate facilities in the same sector to improve their compliance with safety

and health regulations and to experience fewer occupational injuries. According to Dr. Johnson, this suggests that OSHA would have to conduct at least 40 additional inspections to achieve the same improvement in compliance as that achieved with a single press release."[13] (Emphasis added.)

Even if it turns out that the effect of OSHA press releases is only fraction of what Johnson estimates, there is still no doubt that OSHA press releases can influence employer behavior and therefore reduce injuries and save lives.

Recordkeeping

The injury recordkeeping and reporting components of the OSHAct are not simply paperwork requirements – they are fundamentally important in preventing workplace injury. Many employers are required to maintain a log of work injuries, logs that are roadmaps for prevention of future injuries. These logs are used by OSHA inspectors and, starting in 1996, some employers were required to send summary data from those logs to the agency under the OSHA Data Initiative. OSHA used this data to identify employers with high injury rates and to target enforcement inspections to these establishments.

Recognizing that injury data could be used more effectively and efficiently, we focused on modernizing injury recordkeeping and reporting.

In 2015, OSHA implemented its Severe Injury Reporting Program, which for the first time, required employers to report all hospitalizations, amputations and loss of an eye. Previously, employers were only required to report fatalities or multiple hospitalizations to OSHA. Before this regulation was issued, a serious incident could have hospitalized two workers with severe, life-threatening and permanent injuries, but OSHA may never have known. Now OSHA is notified of all hospitalizations and amputations, and is able to decide whether an inspection or some other intervention is necessary.

The Severe Injury Reporting Program is an example of how OSHA can be collaborative without sacrificing enforcement. The program is guided by the principle that when employers engage with OSHA after a worker suffers a severe injury — whether or not a workplace inspection is launched — they are more likely to take action to prevent future injuries. The majority of severe injury reports did not result in an inspection. Instead, OSHA conducted a Rapid Response Investigation, a collaborative, problem-solving approach that invited the employer and an OSHA Area Office expert to work together toward the shared goal of fixing hazards and improving overall workplace safety.[14] The agency's report on the first year of the program is attached to this testimony.

In 2016, OSHA also issued the Improve Tracking of Workplace Injuries and Illnesses Rule (commonly known as the Electronic Recordkeeping Rule), applying the insights of behavioral economics to improve workplace safety and prevent injuries and illnesses, without conducting additional inspections.[15]

The rule requires employers with 20 or more employees to electronically the annual summary data that employers have already prepared – the same information that was submitted under the earlier OSHA Data Initiative, without a requirement for electronic reporting. After some needless delay, the Department of Labor implemented this component of the rule in December, 2017.

The rule also requires large employers with 250 or more employees to electronically report to OSHA more detailed information about serious workplace injuries. These additional data provide information on the type of injury and the exposures or conditions that caused the injury and would allow OSHA and others to use the data to focus on serious hazards of particular concern. Moreover, the electronic collection of this data provides OSHA a powerful new mechanism for conducting outreach and providing compliance assistance to tens of thousands of employers. OSHA can electronically provide feedback to reporting employers – tools to help employers analyze injury records and identify problems, links to resources on hazard abatement and control, and data to allow employers to benchmark their performance against others in the industry. Under the regulation, OSHA is required to collect these detailed data by July, 2018.

However, instead of moving forward with the implementation of this important new injury prevention initiative, the Department of Labor has announced that it plans to repeal the requirement for employers to submit detailed injury and illness information to the agency. In contrast, the Mine Safety and Health Administration (MSHA) requires mine operators and contractors to submit more comprehensive data on all mine accidents, injuries and illnesses, and MSHA has made these data publicly available through posting on its website for years.[16]

Another important component of this rule is the public posting of these data. Just as public disclosure of their kitchens' sanitary conditions encourages restaurant owners to improve food safety, OSHA recognized that public disclosure of work injury data will encourage employers to increase their efforts to prevent work-related injuries and illnesses. Since high injury rates are a sign of poor management, and no employer wants to be seen publicly as operating a dangerous workplace, new reporting requirements will "nudge" employers to prevent worker injuries and illnesses to demonstrate to investors, job seekers, customers and the public that they operate safe and well-managed facilities. Access to injury data will also help OSHA better target compliance assistance and enforcement resources at establishments where workers are at greatest risk and will enable 'big data' researchers to apply their skills to making workplaces safer.

It is very disturbing that the Department of Labor is refusing to release to the public the data that has already been collected under this rule. OSHA's website already contains similar data from 2002 through 2011 for tens of thousands of employers submitted under OSHA's earlier data initiative.[17] Failure to post these data, and to collect by July 2018 the additional required by this rule, will represent a lost opportunity for OSHA to apply modern electronic tools and insights from behavioral sciences to prevent injury and illness without conducting additional inspections.

One argument that has been used against this rule is that OSHA will require employers to send in confidential information that cannot be safeguarded. This is a myth. Before we issued the regulations, OMB required OSHA to ensure that there were effective safeguards in place to prevent the disclosure of personal or confidential information contained in the recordkeeping forms and submitted to OSHA. OSHA will not collect employee name, employee address, name of physician or other health care professional, or healthcare facility name and address if treatment was given away from the worksite. All of the case specific narrative information in employer reports will be scrubbed for personally identifiable information using software that will search for, and de-identify, personally identifiable information before the data are posted.

Much more can be done using injury recordkeeping and reporting to prevent injuries from occurring. The National Academy of Sciences, Engineering, and Medicine recently released a

report written by a distinguished panel of experts calling for OSH surveillance efforts to leverage newer technologies and tools for identifying, organizing, analyzing, and interpreting data in more innovative, powerful, and cost-effective ways. In doing so, the report stated, the data could reveal problems, trends, and emerging issues within and across sectors, groups, and geographic regions of workers. In addition, new technologies, including OSHA's electronic injury reporting can help disseminate the information to employers and worker organizations who can use surveillance data to take preventive action, thereby improving worker safety and health and reducing associated human and economic costs of work-related injuries and illnesses.[18]

I was very pleased with the recommendations of this report, which were agreed upon by all members of the study panel including Scott Mugno, the nominee for the position of Assistant Secretary of Labor for OSHA. Hopefully, under Mr. Mugno's leadership, OSHA will move promptly to implement these recommendations, including fully implementing OSHA's electronic injury reporting rule.

Complete and accurate injury records are of fundamental importance for any of these systems to work. Unfortunately, this administration and Congress took a major step backwards in ensuring recordkeeping accuracy with the repeal of the so-called Volks Rule that had allowed OSHA for 40 years to cite employers who did not keep complete or accurate injury and illness records over the previous five years.

Throughout OSHA's history, this had enabled both Republican and Democratic administrations to issue major citations for widespread recordkeeping violations, to identify deliberate patterns of under reporting, and to require improvements, not just of those employers' recordkeeping practices, but of their unsafe work practices. These led to major changes in such dangerous industries as meatpacking, auto, chemical and others.

Unfortunately, the repeal of this rule now makes it impossible for OSHA to cite most employers' recordkeeping violations in any meaningful way and workers will pay the price in preventable injuries and illnesses. Badly needed here is legislation to restore OSHA's authority to cite employers who do not maintain accurate injury logs, and I support passage of H.R. 2428, "The Accurate Workplace Injury and Illness Records Restoration Act".

Compliance Assistance, Consultation and Cooperative Programs

Compliance assistance also contributes to ensuring that workers come home safe and sound at the end of every workday. But even in this, enforcement plays a role: it is widely recognized that enforcement drives collaborative programs. Remove the obligation to comply and fewer employers will seek compliance assistance. During the Obama Administration, we felt that no employer should expose workers to hazards because the employer lacked knowledge of the hazard. Many employers – especially small employers -- need assistance in learning how to abate hazards, and OSHA has historically provided that. We recognized that small employers often could not afford to hire safety and health staff, or even consultants, so we focused on strengthening OSHA's On-site Consultation Program within the budgets that Congress provided. Similarly, workers need information about the hazards they face, what to do about them, and their rights under the law. This is why we provided both employers and workers with strong and active consultation and cooperative programs.

Under my leadership, we issued important guidance documents and expanded our website that gets millions of hits a year. We launched major national campaigns, promoting safety and health management systems, fall protection, and heat safety. The heat campaign featured a smartphone heat safety tool that has been downloaded hundreds of thousands of times. We strengthened our Alliance program, expanding it to new industries like the National STEPS Network with the upstream oil and gas industry, the Temporary Worker Initiative featuring close collaboration with the American Staffing Association, and new voluntary initiatives involving cell tower climbers, waste recycling, grain handling, hospitals, and many other high hazard industries.

In addition to expanding and restructuring the Whistleblower program, we formed a Whistleblower Protections Advisory Committee, composed of labor, management and government representatives, and asked this committee how we could work more collaboratively with employers. The members of the committee took up the challenge and drafted a recommended practices document and unanimously submitted it to the agency. We then published this as OSHA's Recommended Practices for Anti-Retaliation Programs[19] and the members of this committee are currently promoting the use of these guidelines to employers and employer groups.[20] Shortsightedly, the Trump administration has proposed eliminating this valuable, hard-working and well-balanced committee.

We also made a major effort to ensure that vulnerable workers were aware of the hazards they faced and their rights under the law. Day laborers and temporary employees who may have a different employer every month or every week or every day, were particularly hard for OSHA inspectors to reach. Other workers who did not have English as a first language and were not familiar with OSHA also needed specialized information.

One proven, effect program that helped protect vulnerable workers, and workers in small businesses is OSHA's highly successful Susan Harwood Training Grant Program. We focused these grants on high hazards industries, like tree care, (including multiple grants to the Tree Care Industry Association), construction and poultry processing, workers employed by small businesses, and organizations that train the vulnerable workers that OSHA has difficulty reaching.

And these efforts have paid off. After Superstorm Sandy and Hurricanes Harvey, Irma and Maria, for example, organizations that had received Harwood grants were there to ensure that the day laborers, immigrant workers and others were on the ground, ready, and able to safely rebuild the cities that had been devastated by the hurricanes. Without the training provided by Harwood grantees, I believe that many more workers would have been injured or killed in the recovery effort.

OSHA's consultation and cooperative programs – like the Voluntary Protection Programs (VPP)-- supplement OSHA's enforcement efforts but are limited in their effectiveness. Standards and strong, fair enforcement impact multiple employers at the same time. There is compelling evidence they are effective in preventing injuries. In contrast, most of OSHA's cooperative programs focus on individual employers, and have no strategic focus. The fact is, most of these efforts don't have broad widespread impact on hazards or industries.

We also worked hard to strengthen the Voluntary Protection Program. VPP is designed to recognize "the best of the best," establishments that had well-functioning safety and health management programs that exceeded OSHA's requirements. To function well, VPP requires use

of extensive resources: agency staff must conduct a wall to wall inspection in these plants prior to entry into the program, and then must complete a sizable amount of paperwork. Further, VPP participants need to go through an exhaustive re-approval process every three to five years.

Unfortunately, when we arrived, the program was in crisis. The previous administration had rapidly expanded the program but did not have the resources to ensure its integrity, nor could OSHA vouch that every participant in VPP was in fact was one of the best and deserved the recognition and inspection exemptions that VPP provided. Some VPP establishments had experienced fatalities and received willful citations, yet were allowed to remain in the program.

This should have been no surprise to anyone. A June 2009 GAO report warned that the uncontrolled growth of the program threatened its integrity. Noting that the number of participants in VPP had more than doubled from 2003 to 2008, the GAO warned that OSHA was not ensuring that only qualified sites participated in VPP. Specifically, OSHA was allowing participants that had experienced fatalities and serious injuries to remain in the program without reviewing the adequacy of their programs.[21]

OSHA worked hard to re-establish the program's integrity by issuing new policies to address fatalities and willful violations in VPP establishments. Due to budget restrictions, we were forced to focus on re-approvals of current members, rather than bringing in new members. Although we proposed an efficient mechanism to expand the program by charging a fee for membership, the Voluntary Protection Participants Association (VPPPA) opposed that innovation, condemning the program to shrink as budget resources dried up.

Secretary Acosta has promoted expansion of VPP as a means to improve workplace safety across the country. I understand that desire, as well-functioning safety and health management programs are indeed effective in preventing injuries. I strongly believe OSHA should be doing all it can to ensure that every employer has a well-functioning safety and health management program. During my tenure, we used a public notice and comment process to develop and release updated guidance written to assist all employers, but particularly small and medium sized companies, to develop effective safety and health management programs. I also support the concept of recognizing employers who prove that they can meet and exceed OSHA standards. But for several reasons, OSHA needs to take a hard look at whether expansion of VPP would be an effective use of OSHA's scarce resources.

First, there is no evidence that participation in VPP reduces injury or illness risk. In fact, the argument that VPP participants have better safety records than non-participants confuses cause with effect. While VPP participants clearly have better safety and health records than the average company, they were already dedicated to improving their safety and health programs, they already had good safety records, and saw VPP as a means to get them to a higher level. In other words, these companies are in VPP because of their superior safety records. They don't have superior safety records because of VPP.

There are plenty of well-known companies that have successful safety and health management systems and that prevent injuries just as successfully as any VPP participant but have reached these goals because it is the right thing to do; not because they participated in VPP.

Second, unlike enforcement, no rigorous study has ever been conducted on the effectiveness of VPP. In the past, OSHA requested additional funding for program evaluation but these requests

were rejected by Congress. Now the Trump administration is proposing to eliminate the entire OSHA program evaluation office.

Third, and finally, most VPP companies are large, and among the wealthiest in the country. They have the resources and expertise to implement excellent safety and health programs on their own. It is difficult to justify spending scarce OSHA resources on these large firms with good safety records, when there are so many workplaces with serious hazards and high injury rates that need OSHA's attention.

The bottom line is that OSHA must make some hard decisions about how to prioritize its shrinking resources. Should OSHA put its resources into proven enforcement activities to focus on low-road employers who cut corners and endanger their workers, or put resources into VPP, an unproven program that recognizes high-road employers who already understand the value of workplace safety? Unless OSHA's budget grows significantly, it will be difficult to do both.

Now I'd like to take a moment to talk about some other stakeholders who could not be here today to tell you their stories, four workers who were employed by DuPont, at that company's facility in LaPorte Texas. During my years running OSHA, I received several reports of safety system failures at DuPont facilities. I watched with great concern as the company cut costs and let its safety program deteriorate. Needed repairs and upgrades were delayed, worker training was postponed, and risk assessments were overlooked.

The culmination was an incident at the insecticide plant in LaPorte, when 23,000 pounds of an extremely toxic chemical – methyl mercaptan – was released. Crystle Rae Wise, described as a 53-year-old, dog-loving, Harley-Davidson-riding grandmother with electric blue eyes, was nearby and called for help. Robert Tisnado rushed over, and Wade Baker, one of the managers, followed him in. Robert's brother, Gilbert "Gibby" Tisnado couldn't reach any of his three colleagues, so he hurried over, too. DuPont's emergency response program was profoundly broken. and none had the protection required for the situation.

As a result, all four workers -- Crystle Rae Wise, Robert Tisnado, Wade Baker, and Gibby Tisnado -- were killed.[22]

Would increasing the size of VPP have prevented those four deaths? DuPont knew about VPP – in fact several of its establishments are members. Would more compliance assistance specialists have saved them? No, but if OSHA had the resources to have inspected that facility before the tragedy, it would have seen the dramatic deterioration in safety procedures. But instead of increasing inspections, under the current administration, the number of OSHA inspections is dropping, while at the same time there is talk about increasing resources to voluntary programs.

What we saw at DuPont is true in hundreds of cases I reviewed. Cases where employees were killed because they were not given fall protection equipment; told to go into deep, unprotected trenches; or forced to bypass procedures to fix machines that had not been locked out. In all of these cases, the employer knew what the law required, but chose to cut corners. Like in the DuPont tragedy, more dollars dedicated to VPP would not have saved these lives.

OSHA's job is to stop the carnage. I have never known of a worker being killed because OSHA wasn't being more collaborative.

What is Needed?

Every day, fourteen workers don't return home to their families because they have been killed at work. And each year, tens of thousands more workers die from occupational illnesses and millions are seriously injured at work. This toll is far too high. We can do better and with additional resources and legislative support, there is much more that OSHA can do to save lives and prevent these work-related injuries and illnesses. I hope this Committee and this Congress take action to assist OSHA in the following areas:

- **Enforcement**: Enforcement resources need to be increased and strategically focused on the most significant hazards and the worst employers. The American economy has changed significantly since OSHA was created. Work has shifted from manufacturing to the service sector. More employees are temporary workers, and enforcement and standards need to follow that change from manufacturing to the service sector, especially health care. Focus needs to be put on standards and enforcement programs that protect health care workers, hotel workers and others in the service sector. The workplace has been fissured with more use of independent contractors, temporary employees, and workers dispatched through electronic platforms. OSHA needs to refocus its enforcement strategy and find creative ways to leverage its meager enforcement resources. Any further cuts to OSHA's enforcement budget would have disastrous results for worker safety and health.

- **Standards**: Healthcare workers have among the highest injury rates of any workers in the country, OSHA needs to issue standards that protect these workers – including rules preventing infectious disease transmission and workplace violence. The upstream oil and gas industry is exempt from several important OSHA standards, including Process Safety Management, and in my tenure at OSHA, leaders in that industry implored me to start working on standards to better protect their workers – and to protect the high road employers who should not be at a disadvantage competing with employers who care nothing about their workers' safety. The standard setting process needs to be speeded up significantly while continuing to collect public input and scientific support. Every year it takes to issue a worker protection means more workers are suffering injuries, illnesses and deaths that could have been prevented by speedier process. OSHA should work together with Congress and major stakeholder to speed OSHA's standards development process, and to identify new ways to effectively protect workers from chemical exposures. Finally, standards that protect the public's safety and health, including the safety and health of workers, need to be exempted from President Trump's "one in, two out" Executive Order.

- **Outreach:** OSHA needs to develop new ways of reaching workers, especially the most vulnerable workers in this country, and find creative and effective ways of intervening with employers and workers to address hazards. That means strengthening effective programs like the Susan Harwood Training Grant program and growing its other compliance assistance activities targeting vulnerable workers and small employers.

- **Data:** Never before has society had instant access to as much data as we do today. We need to collect those data and use them to be smarter and more effective. For the first

time, OSHA is collecting all severe injury reports as well as electronically collecting injury rates. By law, OSHA should be collecting additional injury reports by this summer, although it appears that the agency may be delaying of discarding this important aspect of the Injury Tracking regulation. OSHA needs to promptly post the data it receives, since by doing so, it can reach hundreds of thousands of employers, encouraging them to abate hazards, providing benchmark comparisons with other employers, and enabling OSHA to efficiently disseminate information and tools to address these problems.

- **Whistleblower Protections**: The founding parents of OSHA saw the need for active worker participation in maintaining safe workplaces. But worker participation is doomed to fail unless workers are safe from retaliation. While we made great strides in improving OSHA's whistleblower program, it is still plagued by enormous problems – lack of funding and weak legislative language being the greatest obstacles to a well-functioning program. The fact that this administration did not ask for an increase in funding for the program, and that the Administration's current budget proposal kills the whistleblower advisory committee suggests this administration's lack of commitment to this program**.**

- **Criminal Prosecution:** Nothing focuses the mind for employers who deliberately flout the law and endanger workers like the prospect of time in jail. My colleagues in the UK tell me that criminal penalties for corporate executives who preside over serious incidents in which there is gross negligence, have led to much improvement in safety. There are minimal criminal penalties for violating the OSHA law. They are limited to situations in which a worker was killed and there was a willful violation – and the penalty in these cases is only a misdemeanor, and it is generally applied to the firm, not an individual like the plant manager. I was heartened to hear Secretary Acosta endorse the concept of criminal prosecution for OSHA violations; however, until there are teeth in the law, prosecutions will lack deterrent value.

- **Public employees:** Eight million public employees in this country remain without the guarantee of a safe workplace despite the fact that many do work every day that is as dangerous – or more dangerous—than work done by private sector employees who receive OSHA protection. Almost 50 years after the OSHAct was passed, public employees continue to suffer a higher injury and illness rate than private sector workers. It's past time for Congress to act to stop treating these workers as second-class citizens whose lives are not worth the same of their private sector colleagues.

In summary, it is a false choice to say that OSHA must choose between strong enforcement and robust compliance assistance. OSHA must do both and during the Obama Administration, OSHA did both. Substituting voluntary programs for life-saving standards and a strong enforcement program would be a dereliction of duty and lead to more workers being hurt.

Tragically, the Trump Administration is already trying to roll back life-saving standards and has failed to fill critical positions, undermining enforcement. Promotion of collaborative programs in place of standards and enforcement will not be as effective in accomplishing OSHA's vital mission: ensuring that employers protect the lives, the lungs and the limbs of their workers.

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Testimony of
Professor David Michaels
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Hearing Before the United States Congress
House Education and the Workforce Committee, Subcommittee on Workforce Protections

A More Effective and Collaborative OSHA: A View from Stakeholders

February 27, 2018

TESTIMONY ATTACHMENTS

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by neutral theory as unnecessary to describe the patterns of species abundances (*21*). Additionally, a recent statistical analysis has called into question the necessity of local interactions to describe patterns of diversity (*22*). Our results run counter to these arguments, as we found support for regional species richness patterns being driven by local species-specific ecological interactions and a local mechanism to explain variation in regional species richness.

It is possible that the patterns found here were generated by mechanisms unrelated to conspecific density dependence that could create spatial separation of adults and conspecific seedlings [e.g., timber harvesting, succession, the mass effect (*23*)]. For example, recruitment differences between early successional and late successional species could imitate patterns of CNDD in forests. To test whether CNDD varies with forest age, we reanalyzed the data set by stratifying the data into early (0 to 39 years), middle (40 to 79 years), and later (80+ years) successional forests. The patterns of CNDD were robust and consistent between age classes, indicating that our results are not contingent on successional dynamics or indirectly on timber harvesting, which has the effect of setting back forest age (figs. S8 to S11).

Janzen (*1*) and Connell (*2*) originally hypothesized that CNDD generated by host-specific seed predators could help maintain the high species richness in tropical forests. We found that CNDD is a strong mechanism maintaining species richness in eastern U.S. forests, but CNDD may also explain the latitudinal gradient in species richness if CNDD becomes stronger with decreasing latitude. We tested this hypothesis in eastern North America, where there is a latitudinal gradient of tree species richness that peaks in the southern Appalachian region (*20*). We found evidence that CNDD could maintain this gradient in tree species richness, as the average regional strength of CNDD was significantly negatively correlated with latitude, ranging from boreal to subtropical forests (Fig. 4). Our results suggest that the strength of CNDD would increase with decreasing latitude into species-rich tropical forests.

Our analyses of the FIA database provide robust evidence that CNDD is pervasive in forest communities and can significantly affect species relative abundance and species richness within and between forests. Further, our results show that species-specific processes acting on seedlings translate into patterns in the abundance and diversity of trees. Several potential interactions could generate CNDD, including intraspecific competition, autotoxicity, seed predators, and soil pathogens. Much research has demonstrated that the soil microbial community can drive CNDD in multiple plant communities, including tropical forests, temperate forests, grasslands, and sand dunes (*18*, *24*). In particular, two studies measuring soil community feedbacks, presumably driven by soil-borne pathogens, have identified a positive relation between strength of CNDD in the greenhouse and relative abundance in the field (*8*, *25*).

Local interactions have previously been considered a local filter on species diversity, but our findings indicate that local interactions feed back to regional species richness and abundance. Further, the prevalence of CNDD across many forest types and diverse species indicates the pervasive importance of these interactions. Our results show that CNDD is a general mechanism structuring forest communities across a wide gradient of forest types and can maintain the latitudinal gradient of tree species richness.

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Acknowledgments: We acknowledge contributions with database consulting from N. Long from the Indiana Univ. Research Database Complex, as well as statistical consulting from S. Dickinson and E. Hernandez at Indiana Statistical Consulting Center and C. Huang at the Indiana Univ. Department of Statistics. Helpful comments were provided by two anonymous reviewers, D. Civitello, C. Her, C. Lively, S. Mangan, S. McMahon, and S. Neumann. We also thank all of the FIA employees that collected and compiled the data that made these analyses possible. The data used for these analyses are publicly available from www.fia.fs.fed.us/tools-data/ under FIA Data Mart. See the supplementary materials for specific dates and conditions applied to the data set.

Supplementary Materials

www.sciencemag.org/cgi/content/full/336/6083/904/DC1
Materials and Methods
Supplementary Text
Figs. S1 to S12
Table S1
References (*26*–*28*)

8 February 2012; accepted 19 April 2012
10.1126/science.1220269

Randomized Government Safety Inspections Reduce Worker Injuries with No Detectable Job Loss

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Controversy surrounds occupational health and safety regulators, with some observers claiming that workplace regulations damage firms' competitiveness and destroy jobs and others arguing that they make workplaces safer at little cost to employers and employees. We analyzed a natural field experiment to examine how workplace safety inspections affected injury rates and other outcomes. We compared 409 randomly inspected establishments in California with 409 matched-control establishments that were eligible, but not chosen, for inspection. Compared with controls, randomly inspected employers experienced a 9.4% decline in injury rates (95% confidence interval = −0.177 to −0.021) and a 26% reduction in injury cost (95% confidence interval = −0.513 to −0.083). We find no evidence that these improvements came at the expense of employment, sales, credit ratings, or firm survival.

The U.S. Occupational Safety and Health Administration (OSHA) is one of the most controversial regulatory agencies in the United States. Some evidence indicates that OSHA penalties deter injuries (*1*), and OSHA supporters argue that inspections save lives at low cost to employers and employees and that additional regulation would reduce tens of thousands of occupational illnesses and hundreds of worker fatalities (*2*, *3*). At the same time, critics fear that OSHA destroys jobs without meaningfully improving workplace safety (*4*, *5*) and have urged the agency to shift its emphasis from worksite inspections to voluntary safety programs (*6*). Even if inspections do improve workplace safety, they might not be socially efficient if

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the cost of remediating hazards outweighs the benefits. The economic theory of perfectly competitive labor markets (with full information, perfect mobility of labor, and so forth) implies that remediating hazards will cause wages to decline so much that employees on average do not benefit from the increase in safety (*7*). If product markets are also perfectly competitive or if wages are sticky, then many inspected firms will either go out of business or at least suffer lower sales, lower employment, and worse credit ratings (*8*).

The debate has persisted in part because prior research has yielded widely varying results. For example, some studies find that OSHA inspections have little or no correlation with subsequent workplace injury rates (*9*–*11*), whereas others find that OSHA inspections correlate with a decline in injury rates (*1*, *12*–*14*). Similarly, workplace-safety inspections correlate with lower productivity in some studies (*15*) but not in others (*16*).

These widely varying results may be due in part to the substantial challenges of measuring the causal effect of OSHA inspections. One challenge arises because most OSHA inspections target workplaces with recent accidents or safety complaints, and these workplaces typically have a combination of ongoing safety problems and a random event ("bad luck") that year. Thus, a cross-sectional analysis revealing a positive correlation between inspections and subsequent injuries does not imply that OSHA inspections cause injuries; it could just be due to ongoing safety problems that spurred the inspection. At the same time, because the random element that contributes to an accident or complaint is temporary, injuries rates often revert to prior levels (*17*), and so inspections often precede a decline in injuries without necessarily causing the improvement, potentially biasing a panel data analysis of targeted inspections.

In addition, most previous studies of the effects of inspections analyze data from logs of workplace injuries that OSHA requires companies to maintain at each workplace. OSHA mandates better recordkeeping when its inspections find incomplete logs, which can erroneously make it appear as if inspections cause higher injury rates. For example, the injury rates reported by very large manufacturing plants more than doubled in the late 1980s after OSHA imposed multimillion dollar fines on a few such plants for poor recordkeeping (*18*).

Fortunately for evaluation purposes, California's Division of Occupational Safety and Health (Cal/OSHA) randomly selected workplaces in high-injury industries for inspections in 1996 to 2006 (*19*). By focusing on these inspections, we simulated a randomized controlled trial that can provide unbiased estimates of the effects of OSHA inspections. To do so, we matched on observables to construct a control group of very similar facilities that were eligible for randomized inspections but not selected.

In addition, we analyzed injury data from the workers' compensation system. Unlike OSHA-mandated logs, workers' compensation data are less likely to be affected by improved recordkeeping after OSHA inspections. Finally, because injuries are not the only outcome that might be affected by OSHA inspections, we also analyzed employment, company survival, and compensation to look for unintended harms from inspections.

The starting point of our analysis was to understand how Cal/OSHA selected establishments for randomized inspections. In each year of our study period (1996–2006), Cal/OSHA identified a list of industries with high injury rates—typically based on data from the U.S. Bureau of Labor Statistics (*19*)—for that year's randomized inspections. For each of these industries, Cal/OSHA used Dun & Bradstreet and other sources to compile a list of establishments with 10 or more employees, then randomly selected a subset of each list. These subsets were then sent to the appropriate northern or southern district managers (each district covers roughly half the state). Within each district, inspectors attempted to inspect all of the randomly chosen establishments, although managers could prioritize on the basis of factors such as avoiding industries they felt were not as dangerous and skipping workplaces that had had an OSHA inspection in the prior 2 years. Our procedure for choosing a sample adjusts for these factors. Specifically, we found controls in the same industry, and we dropped all treatments and potential controls that had had inspections in the prior 2 years.

We obtained data on these inspections from U.S. OSHA's Integrated Management Information System (IMIS). We obtained annual establishment-level data on payroll and on the number and value of workers' compensation claims from the Uniform Statistical Reporting Plan database of the Workers' Compensation Insurance Rating Board (WCIRB). For all California establishments tracked by Dun & Bradstreet, we obtained annual establishment-level data on company names, addresses, whether the establishment was a standalone firm (not a branch or subsidiary), Standard Industrial Classification (SIC) and North American Industry Classification System (NAICS) industry codes, sales, and employment from the National Establishment Time-Series (NETS) database.

We began constructing our analysis sample by identifying in OSHA's IMIS database the 1752 establishments at which Cal/OSHA had attempted a random inspection at least once during our sample period. Because injury data from workers' compensation systems are available primarily at the company level, we restricted our analysis to single-establishment firms. Because Cal/OSHA performed random inspections only at establishments with at least 10 employees, we included only establishments with at least 10 employees in the random inspection year or either of the two preceding years. The pipeline of how we linked these treatments and a set of potential controls to the several data sets and then restricted potential controls to resemble treatments by requiring them to be in the same industry and the same region of California, to be classified as a single-establishment firm, to have 10 or more employees, and so forth is shown in table S1. When more than one potential control matched the industry and region of a particular treatment, we selected the one with the most similar number of employees.

This matching process resulted in a matched sample of 409 pairs of single-establishment firms, whose industry distribution is reported in table S2. At 7% of the treatment establishments in our sample, Cal/OSHA did not carry out the inspection, typically because the inspector could not find the establishment, the establishment had gone out of business, or the inspector determined that the establishment was not eligible for a random inspection after all (for example, if the inspector found out the establishment had fewer than 10 employees). As we could not filter the control sample on these criteria, we included as treatments all establishments in which Cal/OSHA had attempted an inspection. Thus, our estimates measure the causal effect of an attempted inspection and might slightly underestimate the causal effect of the inspections that actually occurred. However, as the vast majority of the attempts were successful, we usually simplify our language by dropping the qualifier "attempted" and referring to our estimates as the causal effect of inspections.

To reduce the effect of very large outliers, we top-coded our measures of injury count (the annual number of workers' compensation claims) and injury cost (the annual value of workers' compensation claims) at their 99th percentiles. We analyzed the logs of our continuous outcome measures: injury cost, sales, employment, and payroll. To reduce the effect of very small outliers, we added roughly the first percentile of nonzero values to our measures ($79 to Injury cost, 10 to Employment, and $100,000 to Payroll and to Sales) before taking logs; our results were not sensitive to these adjustments (*20*). Summary statistics are reported in table S3.

The preinspection characteristics of treatments and controls were very similar on most measures (e.g., employment, payroll, and sales) (table S4). Whereas the treatments averaged 3.7 injuries per year in the 4-year period preceding the randomized inspection and the controls averaged 3.1 over the same period (*t* test *P* value = 0.06), their pretrends (14% decline for treatments, 12% decline for controls) were statistically indistinguishable (*t* test *P* value = 0.85).

For two reasons, we think that the disparity represents sampling variation rather than conscious selection by Cal/OSHA (*21*). First, we closely replicated Cal/OSHA's random selection procedures to create the pool of establishments at risk of a randomized inspection each year. Second, Cal/OSHA had no information on injury rates for the vast majority of establishments

it randomly inspected. In addition, kernel density plots of several key variables the year before the match year (figs. S1 to S3) revealed nearly identical distributions between the treatments and controls, including the variables for which the statistical tests found significant differences.

Even if due solely to sampling error, this imbalance on preinspection injury rates made it important to adjust for preinspection characteristics in our analysis. Thus, we measured the causal effect of inspections via a difference-in-differences analysis. Specifically, we estimated the following model for each outcome Y_{it} at establishment i in year t:

$$Y_{it} = \alpha_i + \beta \cdot \textit{Has been randomly inspected}_{it} + \Sigma_k \gamma_k \cdot \mathbf{X}_{ikt} + \Sigma_t \delta_t \cdot \textit{year}_t + \varepsilon_{it}$$

where α_i was a complete set of establishment-specific intercepts (or, in some specifications, conditional fixed effects). *Has been randomly inspected*$_{it}$ was coded "1" the year an establishment was randomly inspected and each year thereafter and was otherwise coded "0." Of primary interest is β, which represented the estimated effect of a random inspection; that is, the average change in outcome levels pre- versus postinspection. X_{ikt} referred to controls (subscripted k), such as average occupational riskiness and log employment, that were included in some specifications. All models included a full set of year dummies (*year*$_t$). The supplementary materials describe multiple robustness checks for each analysis.

We first analyzed the effects of inspections on injury rates and injury cost and then turned to the possible unintended consequences on firm survival, credit ratings, sales, employment, and payroll. To predict the number of injuries at a workplace, we estimated a negative binomial regression model with establishment-level conditional fixed effects. The point estimate in column 1 of Table 1 indicates that randomized inspections reduce annual injuries by 9.4% [β = −0.099, P = 0.013, incident rate ratio = 0.906, 95% CI = −0.177 to −0.021].

The effects of inspections might attenuate after a few years or might take a few years to emerge. To test for such changes in the effects of inspections over time, we replaced the single posttreatment dummy for inspected establishments with a dummy coded "1" only in the randomized inspection year and a series of dummies for each of the subsequent 4 years. Inspections statistically significantly reduced injuries in the random inspection year and 3 and 4 years later, marginally reduced them 1 year later, but had no significant effects 2 years later (column 2). In short, the reduction in injuries after inspections endured. We found nearly identical annual estimates when we excluded matched groups of which either member (the treatment or control) was inspected 3 or 4 years before the match year (table S5).

To extend our analysis beyond average effects, we also estimated distinct effects of these inspections on the number of minor financial claims (resulting in less than $2000 in workers' compensation) and the number of major financial claims (at least $2000). The results of these two regressions were nearly identical: β = −0.107 for smaller claims and β = −0.136 for larger claims, with $P < 0.05$ in both instances (table S6). These results imply that inspections reduce the rates of both minor and major injuries.

Turning to the cost of injuries, an ordinary least squares (OLS) regression model with establishment-level fixed effects indicates that randomly inspected establishments exhibited a 26% decline in injury cost (column 3, β = −0.298, 95% CI = −0.513 to −0.083, exp(β) = 0.74, $P < 0.01$). When we permitted the effect of inspections to differ by years since inspection, the negative point estimates suggested that inspections consistently reduced injury cost, and we could not reject the equality of all these coefficients (P = 0.09, column 4). The pattern of coefficients resembled the pattern for injury rates, with the year-specific treatment effects statistically significant and larger in magnitude in the year of random inspection and years 3 and 4 after the inspection. Results were nearly identical when we excluded matched groups of which either the treatment or control was inspected 3 or 4 years before the match year (table S5).

Table 1. Regressions yield evidence that randomized OSHA inspections reduced workplace injury rate and injury cost (± standard errors). Standard errors clustered by establishment in OLS models (columns 3 and 4). The models in columns 1 and 2 include establishment-level conditional fixed effects. The models in columns 3 and 4 include establishment-level fixed effects. To reduce the effect of very small outliers, we added roughly the first percentile of nonzero values ($79) to Injury cost before taking the log. To reduce the effect of large outliers, Injury count, and Log Injury cost were top-coded at their 99th percentiles. Sample size in columns 1 and 2 is <409 treatments and <409 controls because the negative binomial specification with conditional fixed effects drops establishments that have no variation in their number of injuries.

	(1)	(2)	(3)	(4)
Dependent variable	**Injury count**		**Log Injury cost**	
Specification	**Conditional fixed-effects negative binomial regression**		**Fixed-effects OLS**	
Has been randomly inspected (this year or before)	−0.099 ± 0.040*		−0.298 ± 0.110**	
Year of random inspection		−0.152 ± 0.053**		−0.379 ± 0.123**
One year after random inspection		−0.023 ± 0.055		−0.217 ± 0.145
Two years after random inspection		−0.033 ± 0.063		−0.085 ± 0.172
Three years after random inspection		−0.135 ± 0.077+		−0.558 ± 0.194**
Four years after random inspection		−0.266 ± 0.091**		−0.455 ± 0.223*
Year dummies	Included	Included	Included	Included
Observations (establishment-years)	5593	5593	5872	5872
Number of establishments	765	765	818	818
Number of treatment establishments	389	389	409	409
Number of control establishments	376	376	409	409
Wald tests				
Dependent variable sample mean	3.43	3.43	7.41	7.41
Each treatment coefficient is equal to zero		X^2 = 15.79		F = 3.17
		P = 0.008		P = 0.008
Sum of treatment coefficients equals zero		χ^2 = 7.72		F = 7.13
		P = 0.006		P = 0.008
All treatment coefficients equal to each other		χ^2 = 10.14		F = 2.02
		P = 0.044		P = 0.091

**$P < 0.01$, *$P < 0.05$, +$P < 0.10$.

Table 2. Regressions yielded no evidence that random OSHA inspections influenced employment, payroll, or sales. OLS coefficients ± standard errors clustered by establishment; effects are not statistically significant ($P > 0.10$). To reduce the effect of very small outliers, we added roughly the first percentile of nonzero values (10 to Employment and $100,000 to Payroll and Sales) before taking logs.

	(1)	(2)	(3)
Dependent variable	**Log Employment**	**Log Payroll**	**Log Sales**
Specification	**OLS**	**OLS**	**OLS**
Has been randomly inspected (this year or before)	0.027 ± 0.016	0.005 ± 0.013	0.002 ± 0.044
Year dummies	Included	Included	Included
Establishment-level fixed effects	Included	Included	Included
Observations (establishment-years)	5278	5872	3190
Number of establishments	787	818	640
Number of treatment establishments	390	409	329
Number of control establishments	397	409	311
Dependent variable sample mean	3.61	14.50	14.86

To assess the impact of inspections on workplace survival, we defined an establishment to have "died" if it had disappeared from both the NETS and the WCIRB databases. We were unable to observe if any treatment or control establishments died after the sample period ended in 2006. Fortunately, censoring does not lead to bias because our matching of controls to treatments was in the year of the randomized inspection; thus, data on each matched pair of treatments and controls were right-censored after the identical number of years. In our sample, 4.4% of the treatment establishments did not survive until 2006, a rate slightly but not economically or statistically significantly lower than the 5.6% death rate among the control establishments ($P = 0.423$).

Although treatment status was randomized, there were differences between the treatment and control groups' preinspection sales, employment, and payroll. We ran several specifications of survival analyses that condition on these characteristics using a logit, a conditional logit with a fixed effect for each matched pair, and a Cox proportional hazard model with each matched pair its own strata. For all models, survival rates of randomly inspected establishments were not statistically significantly different from those of the controls (see table S7). These results yielded no support to critics of OSHA who claim that inspections harm companies' survival prospects.

Because company death is relatively rare, we also analyzed whether random inspections affected establishments' creditworthiness, using Dun & Bradstreet's Composite Credit Appraisal and PAYDEX scores. We used ordered logit regression models to predict Composite Credit Appraisal, an ordinal dependent variable that ranged from 1 to 4. We used OLS regression with establishment-level fixed effects to predict minimum PAYDEX scores, which ranged from 1 to 100. The point estimates were positive—hinting that inspections, if anything, increased creditworthiness—but very close to zero and nowhere near statistically significant (table S8).

To assess whether random inspections affect firm growth, we estimated fixed-effect OLS models to predict log employment, log payroll, and log sales (Table 2). Randomly inspected establishments did not differ significantly from controls in employment, total earnings, or sales, although each point estimate was positive. The point estimates show that treatment increases employment and payroll by small amounts (2.7% for employment and 0.5% for payroll, neither statistically significant) with fairly narrow 95% CIs (–0.5% to +5.8% for employment and –2.0% to +3.0% for payroll). Thus, we rule out large declines in employment and payroll. The coefficient on sales was also tiny and positive (0.2%), but the confidence interval was much wider (–8.4% to + 8.8%).

In sum, workplaces that Cal/OSHA randomly inspected (or attempted to randomly inspect) subsequently experienced substantially lower injury rates and workers' compensation costs compared with a matched set of workplaces that were eligible for, but did not receive, a random inspection. The lower injury rates were not transient.

With many assumptions (see supplementary materials), our point estimates imply that the reduction in injuries in the 5 years after a workplace inspection reduced medical costs and lost earnings by roughly $355,000 (in 2011 dollars) (*22*–*24*). This estimated 5-year total is ~14% of the average annual payroll of this sample of employers. Thus, although admittedly imprecise, the estimated benefits of a randomized safety inspection appear to be substantial. These results do not support the hypothesis that OSHA regulations and inspections on average have little value in improving health and safety.

Although this estimated value of improved health is fairly large, it is crucial to know how much employers pay for these improvements in safety, as well as how much employees pay in terms of lower wages or employment. As noted above (and formalized in an illustrative model in the supplementary materials), economists' benchmark model suggests that the increased costs of safety measures that reduce injury rates can also reduce wages, employment, and rates of firm survival. Although we cannot rule out any of these unintended consequences, we found no evidence that inspections lead to worse outcomes for employees or employers. The point estimates on changes in employment, payroll, sales, and credit ratings were all positive, although all coefficients were small, and none approached statistical significance.

The estimates in Table 2 imply that we can be 95% certain that the mean establishment either grows payroll or experiences a decline of less than $221,000 over the 5 years after the inspection (*25*). The lower-bound estimate of lost payroll is in different units than lost earnings and medical costs, and there is substantial uncertainty about our estimated benefits (with a point estimate of $355,000). With that said, these calculations imply that employees almost surely gain from Cal/OSHA inspections.

This result is not consistent with the perfectly competitive model's prediction that Cal/OSHA's mandated increases in safety would reduce employment and/or earnings sufficiently that, on average, employees would be worse off. These results therefore suggest that it is important to test which assumptions of the perfectly competitive model are sufficiently violated to drive this result (e.g., that employees have very good information on hazards or that labor is perfectly mobile).

Our study has several limitations, including its focus on a subset of companies (single-establishment firms in high-hazard industries and with at least 10 employees) in one region (California), a single type of inspection (randomized, not those driven by complaints or by serious accidents), and a single workplace-safety regulator (Cal/OSHA). Our method also ignores any effects of the threat of inspections on as-yet-uninspected workplaces. It is important to replicate this study in other settings and by using additional study designs to examine the generalizability of our results. It is also important to supplement statistical studies such as this one with qualitative research that helps us understand the process by which workplace regulations affect (and sometimes improve) outcomes.

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21. Cal/OSHA would have had some data on injury rates for workplaces they had recently inspected. Because their procedures were to avoid randomized inspections for workplaces with any inspection in the previous 2 years, we dropped potential treatments and controls that had been inspected within 2 years before the match year. Cal/OSHA only had inspected 7% of treatments in the 4 years before the random inspection year; results were unchanged when we dropped treatments or controls with inspections in the prior 4 years.
22. In the supplementary materials, we show that the cost of reported injuries in medical care and lost wages, not counting pain and suffering, is very roughly $8400 per employee in high-hazard industries in California. If an inspection reduces all costs by the same 26% that we estimated for workers' compensation costs (Table 1, column 3) and if there is an average of 33 employees per employer in our sample, then a Cal/OSHA inspection leads to roughly $71,000 in lower medical costs and lost wages per year. If the effect lasts from the inspection year through the next 4 years (as in Table 1, column 4), the total value to society of an inspection is very approximately on the order of $355,000. This estimate is very rough and ignores the underreporting of injuries (*23*, *24*), safety benefits lasting more than 4 years, the reduction in pain and suffering, and (working in the opposite direction) the discounting of future benefits.
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Acknowledgments: We appreciate the support of C. Baker and I. Nemirovsky of California's Commission on Health and Safety and Workers' Compensation, D. Bellusci and T. Basuino of the Workers' Compensation Insurance Rating Board, and G. Murphy of California's Division of Occupational Safety and Health and helpful comments from F. Neuhauser and J. Sum; A. Nguyen-Chyung and M. Ouellet provided outstanding research assistance. We are grateful for financial support from the Commission on Health and Safety and Workers' Compensation, Harvard Business School's Division of Research and Faculty Development, Kauffman Foundation, University of California at Berkeley's Institute for Research on Labor and Employment, and University of California's Labor and Employment Relations Fund. The publicly accessible portion of the data set analyzed in this study is available at http://hdl.handle.net/1902.1/17936 in the Murray Research Archive at Harvard University (study identifier: 1902.1/17936). That data set contains the following variables: a scrambled establishment ID that uniquely identifies each establishment, the establishment's city, industry, year, year of random inspection, treated (has been randomly inspected), sales, employment, PAYDEX score, and Composite Credit Appraisal. It does not contain the following variables used in the analysis because of the confidentiality conditions under which they were obtained: establishment name, street address, ZIP Code, DUNS number; annual payroll, injury count, injury cost, and average occupational riskiness. Details on how to access all data used in this analysis are provided in the supplementary materials.

Supplementary Materials

www.sciencemag.org/cgi/content/full/336/6083/907/DC1
Materials and Methods
Supplementary Text
Figs. S1 to S3
Tables S1 to S12
References (*26*–*33*)

12 October 2011; accepted 4 April 2012
10.1126/science.1215191

Cost-Benefit Tradeoffs in Engineered *lac* Operons

Matt Eames[1] and Tanja Kortemme[1,2]*

Cells must balance the cost and benefit of protein expression to optimize organismal fitness. The *lac* operon of the bacterium *Escherichia coli* has been a model for quantifying the physiological impact of costly protein production and for elucidating the resulting regulatory mechanisms. We report quantitative fitness measurements in 27 redesigned operons that suggested that protein production is not the primary origin of fitness costs. Instead, we discovered that the *lac* permease activity, which relates linearly to cost, is the major physiological burden to the cell. These findings explain control points in the *lac* operon that minimize the cost of *lac* permease activity, not protein expression. Characterizing similar relationships in other systems will be important to map the impact of cost/benefit tradeoffs on cell physiology and regulation.

Expressing proteins uses cellular resources and thus incurs fitness costs (*1*, *2*). To balance these costs and generate a net fitness advantage, cells must couple protein expression to beneficial processes. These cost/benefit tradeoffs (*3*) shape mechanisms that regulate protein expression, such as those in the *lac* operon (*4*). The fitness costs of protein expression have also been hypothesized to govern the speed at which proteins evolve (*5*, *6*) and to influence the operation of regulatory circuits (*7*, *8*). To interpret these effects and derive predictive models of the physiological consequences of protein expression, the underlying sources of both cost and benefit must be identified and quantified. Such models are central to understanding gene regulation, metabolic engineering, and molecular evolution.

Because costs are balanced or even completely masked by coupled benefits under physiological conditions, cost and benefit can be difficult to separate. We used the *lac* operon (*4*, *9*) (Fig. 1A) to separately quantify the cost and benefit of protein expression (*3*); we define cost as the relative reduction in growth rate due to operon expression and benefit as the relative increase in growth rate in the presence of lactose, the substrate of the operon. To dissect the interplay between proposed cost sources and protein benefit, we quantified the effects of genetic changes that modulate three cost/benefit tradeoffs (*5*): protein production efficiency (*10*) (by changing translational optimization and thereby expression level), functional efficiency (by modulating catalysis), and folding efficiency (*6*) (by altering the propensity to misfold).

To determine the growth response, we induced expression of the *lac* operon using the nonmetabolized inducer isopropyl-β-D-thiogalactopyranoside (IPTG) and varied the concentration of lactose. At low lactose concentrations, the change in growth rate relative to that of uninduced cells is assumed to primarily reflect the cost of protein expression, whereas at higher lactose concentrations, growth reflects both the cost and benefit of lactose metabolism. We performed our experiments at full induction to decouple regulatory effects from the cost and benefit of expression and also to avoid complications arising from bistability at low inducer concentrations (*1*). We knocked out the entire *lac* operon and replaced it with engineered versions at the attTn7 locus (*11*). As a control, we confirmed that a knockin (*KIlac*) of the wild-type *lac* operon successfully recaptured native cost/benefit lactose response curves (fig. S1).

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AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 55:961–963 (2012)

Commentary

OSHA Does Not Kill Jobs; It Helps Prevent Jobs From Killing Workers

David Michaels, PhD, MPH*

I have been promoting the message in the title of this article since I became head of the Occupational Safety and Health Administration in 2009. Although workplace injury and fatality rates have decreased dramatically since OSHA was created, there remain voices doubting the effectiveness of OSHA's inspections.

Now, there is a substantial body of empirical evidence showing that enforcement has a strong, positive impact for both workers and employers. Two studies published in this issue of the American Journal of Industrial Medicine and a paper published recently in the journal Science have convincingly demonstrated that OSHA inspections result in reduced injury risk. Moreover, employers who are inspected by OSHA generally see cost savings exceeding any penalties levied by inspectors. The result is that all the parties involved benefit from OSHA inspections: workers are less likely to be injured and employers' workers' compensation and other indirect costs are reduced.

Examining the impact of federal OSHA inspections on workers' compensation claims among employees of Pennsylvania manufacturing firms, Haviland et al. [2012] report that where OSHA levies a penalty, injury claims fall by 19–24 percent per year during the next two years. Inspections without penalties showed little effect. This paper, ''A new estimate of the impact of OSHA inspections on manufacturing injury rates, 1998–2005'' continues a series of important studies on OSHA effectiveness by John Mendeloff, Wayne Gray and other researchers with the Rand Corporation and the University of Pittsburgh.

Similar results were found by Foley et al. [2012] analyzing the impact of OSHA activities on workers' compensation injury claims in Washington State. These researchers, affiliated with the Safety and Health Assessment and Research for Prevention (SHARP) Program of the Washington State Department of Labor and Industries, examined the effectiveness of inspections and free consultations among fixed site and non-fixed site (often construction) employers. In this study, the effect of enforcement was seen primarily in the prevention of injuries other than musculo-skeletal disorders (MSDs). For those inspections resulting in a citation by Washington State OSHA, lost workday non-MSD claims fell 22 percent during the following year; if an employer had an inspection but no citation, the claims fell about 7 percent, compared with the baseline (no OSHA inspection) of 2 percent.

Both studies are strikingly consistent with the findings of researchers at the Business Schools of the University of California Berkeley and Harvard University, who examined workers' compensation claims following California OSHA enforcement visits. Their findings are well summarized by the paper's title: ''Randomized government safety inspections reduce worker injuries with no detectable job loss.'' They found that workplace injury claims dropped 9.4 percent at businesses randomly chosen by researchers in the four years following an inspection by the California OSHA program, compared with employers not inspected. Furthermore, those same employers saved an average of 26 percent on workers' compensation costs. The positive effects of random inspections were seen among both small and large employers [Levine et al., 2012].

When OSHA compliance officers identify serious hazards, the agency assesses penalties. These penalties are generally not large, averaging a few thousand dollars except in unusual circumstances. It is my experience that

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The author reports no conflicts of interests.

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Accepted 22 August 2012

DOI 10.1002/ajim.22122. Published online 19 September 2012 in Wiley Online Library (wileyonlinelibrary.com).

some employers welcome OSHA as an extra set of eyes, getting a professional safety or industrial hygiene consultation for a cost far less than a professional consultant would charge. Other employers view OSHA inspections less favorably, clinging to an often mistaken belief that no serious hazards exist at their workplace and that none of their workers will be injured as a result.

Together these studies provide a powerful bottom-line response to those critics who question OSHA's value. OSHA inspections not only prevent worker injuries, they reduce workers' compensation costs. Levine et al. calculated that each random inspection saved that employer $355,000 (in 2011 dollars) over five years.

But what about small employers who want to do the right thing, but can't afford to employ a health and safety professional or hire a consultant? For these small employers, there are easier ways to get free safety and health advice than a visit from OSHA enforcement officers. The agency funds free confidential onsite consultation programs in all 50 states, available to employers with 250 or fewer employees. The Washington study was the only one of the three studies that examined the impact of the free consultation service. In that state, the Department of Labor and Industries administers both the enforcement and consultation program and serves as the exclusive workers' compensation insurance carrier for all but the state's largest employers. There, researchers found that consultation visits appeared to result in reduced injuries, although the magnitude of the reduction was not as sizable as that following an inspection with a penalty. In addition, the impact was greater in non-fixed site employers than in those in fixed sites.

It is more difficult to interpret the findings of the impact of consultation visits. Such visits are voluntary, and come only after the employer recognizes a problem and requests assistance. Employers randomly chosen for enforcement actions are representative of all employers, while those who requested a free consultation are not. It is possible that they would have taken actions to abate hazards even without the assistance of the OSHA consultation program.

Following inspections and consultation, employers abate hazards, resulting in reduced exposures and injuries. Another study of more than 500,000 OSHA inspections found total violations decreased by 28–48 percent from the first OSHA inspection to the second one [Ko et al., 2010].

Not all inspections result in penalties. It is clear that the presence and type of citation changes the behavior of employers, resulting in changes to worker injury risk. Inspections accompanied by penalties are now shown to result in reduced injuries. On the other hand, it appears that inspections not accompanied by penalties have little or no impact on injury rates. Haviland et al. [2012] found this to be true in manufacturing sites, and Foley et al. [2012] reported this for non-MSD cases in both fixed site and non-fixed (e.g., construction) employers.

Some types of citations encourage employers to comply with specific standards, while others impact employers more widely and lead to reduction in injuries not associated with violating the standard for which the citation is issued. This can be seen in the Washington State analysis, as well as in an earlier paper by the Rand group that examined injuries in Pennsylvania manufacturing firms [Haviland et al., 2010]. There, violations of the Personal Protective Equipment (PPE) standard were associated with larger reductions in injuries than other sorts of violations. Workers at facilities cited for PPE standard violations showed reductions in all types of injuries: those associated with the standard cited, as well as injuries unrelated to the specific standard, including MSDs. PPE standards have programmatic requirements; compliance is more than a simple engineering fix, often requiring broader consideration of the specific hazards in the facility and ways to ensure adequate worker protection.

Taken together, the consistent findings of these three studies, conducted in three different states by researchers independent of each other (and all independent of OSHA), are most convincing: OSHA inspections prevent injuries. But do OSHA inspections kill jobs? Do they threaten business survival by raising costs? The analysis of California OSHA inspections found that inspections had no negative impact. According to David I. Levine and Michael W. Toffel, the Business School professors who authored the study:

> Workplace inspections not only improve safety, they cause no discernible damage to employers' ability to stay in business and no reductions in sales or credit ratings, according to our research. Nor did we identify any effects of workplace inspections on wages, total payroll, or employment [Levine and Toffel, 2012].

It is clear OSHA inspections prevent workplace injuries, while saving employers money and protecting jobs. Translated to the nation as a whole, OSHA inspections nationwide could be saving employers $20 billion annually [Levine and Toffel, 2012].

The findings of this body of literature should finally put an end to the myth that OSHA inspections make running a business more expensive without adding value. The fact is: OSHA inspections save lives and jobs.

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March 17, 2016

Year One of OSHA's Severe Injury Reporting Program: An Impact Evaluation

By David Michaels, PhD, MPH
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Every year, tens of thousands of men and women across the United States are severely injured on the job, sometimes with permanent consequences to themselves and their families.

But until last year, the Occupational Safety and Health Administration (OSHA) lacked timely information about where and how most of those injuries were occurring, limiting how effectively the agency could respond. Too often, we would investigate a fatal injury only to find a history of serious injuries at the same workplace. Each of those injuries was a wake-up call for safety that went unheeded.

Now, under a requirement that took effect Jan. 1, 2015, employers must report to OSHA within 24 hours any work-related amputation, in-patient hospitalization, or loss of eye. (The requirement to report a fatality within 8 hours was unchanged.) Injuries may be reported directly to an OSHA field office, to the OSHA toll-free number, or via an online form; details are available at www.osha.gov/report.html. OSHA instituted the new reporting requirements to:

1. Enable the agency to better target our compliance assistance and enforcement efforts to places where workers are at greatest risk, and;
2. Engage more high-hazard employers in identifying and eliminating serious hazards.

Experience in the field and data from more than 10,000 reports of severe injuries tell us that both goals are being met. We are confident that the events triggered by these reports have eliminated the potential for many more thousands of injuries in U.S. workplaces.

The 2015 experience

In the first full year of the reporting program, employers notified OSHA of 10,388 incidents involving severe work-related injuries, including 7,636 hospitalizations and 2,644 amputations.

The reports were from federal OSHA states only and do not include injuries from states that administer their own safety and health programs. Even so, the numbers amount to 30 work-related severe injuries a day — evidence that, despite decades of progress, many U.S. worksites remain hazardous to workers.

Injury reports were filed from towns and cities across the country, by businesses large and small: A pharmaceutical lab in New Jersey, a supermarket in Florida, a boat builder in Connecticut, and an erosion control firm in Pennsylvania were among the broad range of affected workplaces.

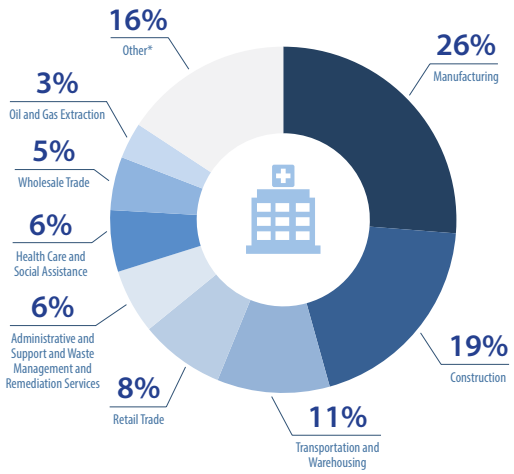
For a breakdown of hospitalization and amputation reports by industry, please see Figure One: Reports filed by industry sector. The 25 industry groups reporting the largest number of severe injuries can be found in Table One. A complete list of injury reports by industry is available at www.osha.gov/injuryreport/2015_by_industry.pdf.

Most of the hazards that led to these severe injuries are well-understood and easily prevented. They also account for a majority of work-related fatal injuries. And we know that, in most cases, employers can abate them in straightforward, cost-effective ways, such as by providing fall protection equipment, installing guarding over dangerous machinery, or clearly marking pathways.

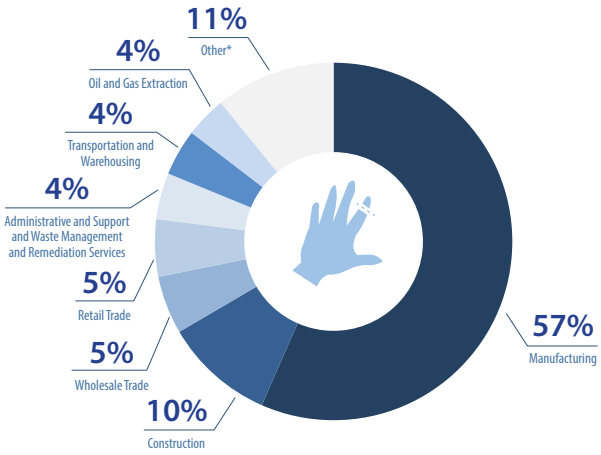
One important objective of our program is to encourage employers to evaluate their own processes and equipment and determine what went

Figure One: Reports filed by industry sector

7,636 HOSPITALIZATION REPORTS



2,644 AMPUTATION REPORTS



* Other industry sectors include: Accommodation and Food Services; Other Services (except Public Administration); Agriculture, Forestry, Fishing, and Hunting; Professional, Scientific, and Technical Services; Public Administration; Arts, Entertainment, and Recreation; Information; Utilities; Real Estate and Rental and Leasing; Educational Services; Finance and Insurance; and Management of Companies and Enterprises.

wrong. Working with OSHA, many employers have found ways to eliminate hazards and protect other workers from the same injuries. Nothing illustrates this more powerfully than actual cases, workers injured in incidents that OSHA learned about because of the new reporting program:

- In Chicago, a conveyor loaded with liquid chocolate suddenly started up as a worker was cleaning a roller. Her arm was pulled in and mangled so badly that its repair required a plate and skin grafting. To prevent future injuries, the employer installed metal guards to shield workers' arms and hands from moving machinery as well as warning alarms and flashing lights that are activated 20 seconds before the conveyor moves.
- In Idaho, a valve cover snapped shut on the hand of a truck driver who was loading creamer into a tanker, severing his fingertip. Drivers had long known the valve was problematic. After the amputation, the employer devised a new hands-free tool for closing the valve, and alerted the manufacturer and other employers likely to use the same equipment.
- At a wastewater treatment facility in Illinois, a worker was overcome with heat exhaustion and hospitalized. The employer immediately instituted more frequent employee breaks with water provided, and within weeks had installed cooling fans and submitted plans for a new ventilation system to control worker exposure to excessive heat.
- When a mechanized blender at a meat processing plant in Missouri suddenly started up, it caused the amputation of both lower arms of a sanitation worker who was cleaning the machine. The employer immediately re-engineered the blender's computer control

Table One: Top 25 Industry Groups Reporting Severe Injuries (by 4-Digit NAICS)

NAICS Title	NAICS	Severe Injury Reports
Foundation, Structure, and Building Exterior Contractors	2381	391
Building Equipment Contractors	2382	343
Support Activities for Mining*	2131	323
Nonresidential Building Construction	2362	271
Postal Service	4911	229
General Medical and Surgical Hospitals	6221	221
Grocery Stores	4451	215
Animal Slaughtering and Processing	3116	213
Utility System Construction	2371	201
Plastics Product Manufacturing	3261	196
Services to Buildings and Dwellings	5617	187
Highway, Street, and Bridge Construction	2373	162
Other Specialty Trade Contractors	2389	159
Employment Services	5613	158
Warehousing and Storage	4931	157
General Freight Trucking	4841	155
Architectural and Structural Metals Manufacturing	3323	146
Other Wood Product Manufacturing	3219	139
Building Finishing Contractors	2383	124
Other Fabricated Metal Product Manufacturing	3329	112
Sawmills and Wood Preservation	3211	104
Electric Power Generation, Transmission and Distribution	2211	101
Grocery and Related Product Merchant Wholesalers	4244	100
Ship and Boat Building	3366	97
Converted Paper Product Manufacturing	3222	94

* Consists of Drilling Oil and Gas Wells and Support Services for Oil and Gas Operations

system and changed safety interlocks, and enhanced worker training and supervision, significantly reducing the risk of amputation. Thankfully, the worker's arms were later surgically reattached and he is undergoing rehabilitation.

What we have seen over and over again is that the prompt reporting of worker injuries has created opportunities for employers to work with OSHA specialists to keep similar incidents — or worse — from happening again.

Our goal is safer workplaces

The new program is guided by the principle that when employers engage with OSHA after a worker suffers a severe injury — whether or not a workplace inspection is launched — they are more likely to take action to prevent future injuries.

We responded to 62% of the 2015 reports, including 69% of hospitalization reports, not by sending inspectors to the scene but by asking employers to conduct their own incident investigations and propose remedies to prevent future injuries. We provide employers with guidance materials developed by OSHA and by the National Safety Council to assist them in this process.

Known as a Rapid Response Investigation (RRI), this collaborative, problem-solving approach invites the employer and an OSHA Area Office expert to work together toward the shared goal of fixing hazards and improving overall workplace safety.

In a typical RRI, the employer analyzes the incident to identify the causes, and presents to OSHA its findings and proposed abatements — which can include changes to processes and equipment as well as training. The conversation may be in person or by phone and email, and abatements may be verified with blueprints and photos.

This was how OSHA officials in Hawaii worked with the employer at a tuna cannery in remote American Samoa, following the amputation of a worker's finger. OSHA officials consulted with the employer

When a temporary worker is injured, who is responsible for notifying OSHA?

It's important to remember that both host employers and staffing agencies have roles in complying with workplace health and safety requirements and they share responsibility for ensuring worker safety and health. Therefore, it is essential that both employers comply with all relevant OSHA requirements. *The employer who provides the day-to-day supervision of the worker must report to OSHA any work-related incident that results in a worker fatality, in-patient hospitalization, amputation or loss of an eye.* The first year data shows that more than 6% of the Severe Injury Reports involved a temporary worker.

by phone on the day of the incident, and by the following week, the cannery had provided a detailed report and designed and installed an improved guard on the canning machine.

Even when a severe injury occurs around the corner from a field office, OSHA officials often choose to respond via RRI rather than an inspection. We have found this process to be extremely effective in abating hazards while also using far fewer OSHA resources than are required for on-site inspections. In this way, we are able to use agency resources more efficiently and, ultimately, better protect the safety and health of workers.

Reporting leads to productive inspections

OSHA responded to about a third of all injury reports, and 58% of amputation reports, with an inspection by a compliance officer after determining that the hazardous conditions described warranted one.

These inspections enabled OSHA to investigate firsthand the immediate cause of the incident and learn whether hazards remained to threaten the safety and health of additional workers. In most cases, OSHA would never have learned about the hazards had it not been for the severe injury report. These inspections also opened a door to some emerging and fast-changing industries that have had relatively few OSHA inspections, such as suppliers to oil and gas operations.

Most employers who experienced a severe injury to a worker were eager to cooperate with OSHA inspectors to prevent anything similar or worse from happening again. In fact, many went above and beyond what was required by OSHA to protect their employees.

At a sawmill in Idaho, a chipper operator's arm was amputated after he tried to clear a jam in a conveyor. In response, the owner closed the sawmill for a week and made improvements that went far beyond what OSHA required, including installing electrical shut-offs within easy reach of all workers, placing catwalks around the entire mill, and providing handheld radios for all employees to improve communications.

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In a small Illinois town, a worker at a food processing plant was hospitalized with severe injuries after his arm was mangled in a screw conveyor. Following an inspection that resulted in citations, the employer installed guards and hand rails around the machinery, added a nitrogen monitoring system for another part of the plant, and conducted extensive employee training. Then he urged other employers in the area to check for hazards, and invited OSHA to make a safety presentation to the local Chamber of Commerce.

Food Slicer Amputations

Soon after the requirement to report severe work-related injuries took effect, OSHA's southeast regional office noticed a surprising trend: Numerous reports of fingertip amputations among workers using food slicers in supermarket delis and restaurants. The Atlanta-based staff quickly developed a plan to contact food service employers across the region — which spans eight states — with information about the hazards of food slicers and simple, low-cost ways to keep workers safe. A letter from Regional Administrator Kurt Petermeyer and a newly developed fact sheet on Preventing Cuts and Amputations from Food Slicers and Meat Grinders was distributed by email and postal service to more than 3,000 locations, from major national supermarkets to small individually owned groceries, as well as many federal facilities, including military bases, federal prisons, and VA hospitals. Compliance specialists also placed an article on deli slicer hazards in a widely distributed industry publication, Edge Magazine. Because of the new reporting requirement, OSHA was able to spot an unrecognized hazard and take fast action to prevent future injuries.

In hundreds of cases that we learned about through the new program, we have seen that our interactions with employers through inspections have inspired larger changes in the company's overall safety program. Some employers have changed their incentive programs to reward activities that abate hazards and prevent injuries, rather than offering prizes for not reporting injuries. Others hired safety and health consultants to review potentially hazardous work practices, or signed up for OSHA's free and confidential on-site consultation services.

Revealing patterns and attempts to conceal

The new reporting requirements have also led OSHA to employers who, even after experiencing horrific employee injuries, continue practices that put workers at risk. Some have gone to great lengths to try to hide hazards in order to avoid fixing them.

In one stunning example, a manufacturer tried to conceal an entire production line from OSHA inspectors after a staffing agency reported the amputation of a worker's finger. When inspectors arrived, the employer closed interior doors and parked forklifts in front of them, then turned off the lights and told workers to be quiet. Inspectors who uncovered the back room found a row of machinery with exposed parts that could have caused other workers to lose their fingers.

In another case, OSHA inspectors learned through witnesses that a temporary worker had asked in vain for fall protection before he fell through the roof on a construction project, sustaining multiple fractures

and other severe injuries. An investigation found that, rather than immediately report the incident, the employer delayed three days while he bought the required fall protection gear and coached other workers to claim they'd had it all along. They were told to blame the victim for not wearing it.

Reporting has also revealed recurring patterns of injuries at certain workplaces. OSHA compliance officials could barely keep up with the reports from a single food processing facility in Georgia. There, within six weeks, one worker lost a finger, another lost a hand, and a third was hospitalized with burns and lacerations. Prior to the new requirements, OSHA would not have learned about any of these injuries.

Some Employers are Not Reporting Severe Injuries

OSHA believes that many severe injuries — perhaps 50% or more — are not being reported. We base this conclusion on several factors, including injury claim numbers provided to us by state workers' compensation programs.

Because the majority of first year reports were filed by large employers, we believe that many small and mid-sized employers are unaware of the new requirements. For them, we are developing outreach strategies, including working through insurers, first responders, and business organizations.

In other cases, employers are choosing not to report because they perceive the cost of not reporting to be low. They should know that, now that the requirement is in its second year, OSHA is more likely to cite for non-reporting. In addition, the agency recently increased the unadjusted penalty for not reporting a severe injury from $1,000 to as much as $7,000. And that amount will increase even more when higher penalty levels recently approved by Congress take effect.

If OSHA learns that an employer knew about the requirement but chose not to report it promptly, the fine can be much higher. Already, one employer has been assessed enhanced penalties of $70,000 for willfully failing to report.

Conclusions

Results from the first year of severe injury reporting demonstrate the program's success in both helping OSHA focus its resources where most needed, and engaging employers to identify and eliminate serious hazards at their workplaces.

OSHA will continue to evaluate the program and make changes to improve its effectiveness. For example, we are refining guidance to the field about when a Rapid Response Investigation is appropriate and when an inspection should be called. And we are seeking new ways to make sure that small employers know about their reporting obligations and the resources available to them.

Beyond the numbers and the success stories, we know that each case reported to us under this new requirement involved a human being who went to work one day and suffered an unexpected trauma. Some, along with their co-workers and families, were changed forever. To help bring meaning to their suffering, we can at least ensure that all severe work-related injuries are reported to OSHA, and that they lead to safer working conditions for others.

Occupational Safety and Health Administration

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