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# The power of local action in occupational health: the adoption of local exhaust ventilation in the Chicago tuckpointing trade

Marc Weinstein<sup>1</sup> , Pam Susi<sup>2</sup> , Mark Goldberg<sup>3</sup> 

<sup>1</sup>Department of Management and International Business, Florida International University, Miami, FL, USA, <sup>2</sup>CPWR – The Center for Construction Research and Training, Silver Spring, MD, USA, <sup>3</sup>School of Public Health, City University of New York, New York, NY, USA

**Background:** Silica is a pervasive and potentially deadly occupational hazard in construction. The occupational risk posed by silica has long been known, but efforts to use engineering controls to minimize dust generation in tuckpointing operations, a masonry restoration specialty, have been slow.

**Objectives:** The objective of this study is to explore how local innovation in occupational safety and health may emerge, absent the establishment of national standards.

**Method:** This study uses a case study to explore the adoption of local exhaust ventilation in tuckpointing operations in the Chicago area. Sources of data for this research include interviews with a diverse range of key informants and the review of archival material.

**Results:** This case study found local unions, municipal regulators, contractors, and major public users of construction services played a central role in the events and milestones that led to the early adoption of local exhaust ventilation in Chicago. The adoption of local exhaust ventilation technology in Chicago demonstrates the potential for local actors to fill an important void when rulemaking in vital areas of occupational health impedes effective national regulation.

**Keywords:** Silica, Construction, Occupational health, Tuckpointing, Local exhaust ventilation

## Introduction

The twentieth century witnessed considerable improvement in the safety and health of U.S. workplaces. The Centers for Disease Control and Prevention estimated that if workers in 1997 had the same risk of workplace fatalities as in 1933, there would be an additional 40,000 occupational deaths annually.<sup>1</sup> Data from the Survey of Occupational Injuries and Illness indicate that the rate of total recordable injury and illness cases declined 30% from 5.0 per 100 full-time equivalent workers in 2002 to 3.5 in 2011.<sup>2</sup> While some improvement is attributable to technological advances and the decline of industries with the greatest occupational hazards, regulation, and advocacy have also made U.S. workplaces safer.

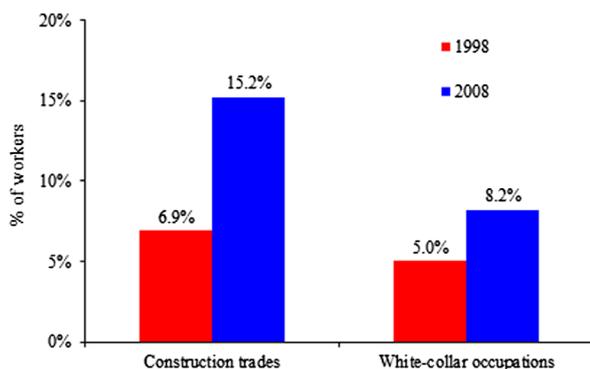
While these advances are notable, room for decreasing the number of occupational illnesses still exists. One area for improvement is respiratory disease, which poses high risk in construction. In contrast to improvements in other areas, the prevalence of lung disease among older construction workers increased from 1998 to 2008 (Fig. 1).<sup>3</sup> Based on national surveillance data reported by the National Institute for Occupational Safety and Health (NIOSH), workers in construction constituted close to

one-quarter of all asbestosis deaths between 1990 and 1999.<sup>4</sup>

Construction accounts for the largest number of silicosis deaths in the U.S. each year. Roughly 6.5% of the U.S. civilian workforce is employed in the construction industry; however, 13.5% of silicosis deaths were in construction between 1990 and 1999, the latest period for which construction industry data are available.<sup>3,5</sup> Using “years of potential life lost” (YPLL) as another measure of morbidity, CDC analysis of mortality data from 1968 to 2005 found that while YPLL from silicosis declined overall, the proportion attributable to young silicosis decedents (15–44 years old) increased with an estimated 3600–7300 new cases annually. Among 46 industries reported, the greatest YPLL were in construction.<sup>6</sup>

Against this backdrop, we examine the case of the successful adoption of local exhaust ventilation (LEV) to reduce dust exposure in tuckpointing operations – a masonry restoration specialty associated with extremely high exposure to silica dust. Tuckpointers repair masonry by grinding out old mortar and replacing or repointing with fresh mortar. They commonly use electric grinders to remove deteriorated mortar, creating dense clouds of silica containing dust (Fig. 2). Occupational Safety and Health Administration (OSHA) found that over half of silica exposures measured among tuckpointers were greater

Correspondence to: Marc Weinstein, Department of Management and International Business 338A RB, College of Business Administration, Florida International University, 11200 S.W., 8th St., Miami, FL 33199, USA. Email: weinstei@fiu.edu



**Figure 1** Lung diseases among older construction workers in 10-year follow-up construction trades vs. white-collar occupations, 1998 vs. 2008 (All employment).



**Figure 2** Tuckpointer grinding mortar without LEV.

than  $0.1 \text{ mg/m}^3$  – two times the NIOSH’s Recommended Exposure Limit or REL.<sup>7</sup>

Silica is present in the material that tuckpointers grind so the hazard cannot be eliminated by substitution with a less hazardous material. Following the NIOSH-endorsed “hierarchy of controls” in safety and health,<sup>8</sup> one engineering solution is LEV that captures dust at the point of generation, minimizing silica release into the ambient air and reducing the inhalation hazard (Fig. 3). Based on conversations with union and contractor representatives at national and regional meetings dating back to the late 1990s as well as reports from trade union representatives, contractors, and manufacturers participating in a workgroup jointly sponsored by the Center for Construction Research and Training (CPWR) and NIOSH, there seems to be a general consensus that the adoption of LEV has been slow despite its health advantages.



**Figure 3** Grinding mortar with LEV (Photo courtesy of Neil Lippy).

The early adoption of LEV in the masonry restoration industry in Chicago is notable for a number of reasons. First, the commercial use of LEV in masonry demonstrates that current work practices in construction can be adapted to meet emerging regulatory requirements related to silica exposure. Second, the Chicago case also illustrates the potential of local actors to promote solutions in safety and health. Our analysis of the Chicago case finds that OSHA’s leadership in this area was important, but does not alone explain early adoption of LEV for use in the construction industry. Rather it was a combination of forces that led to the early adoption of LEV in Chicago, including: local OSHA regulatory enforcement, local unions, municipal regulators, contractors, and major public users of construction services. This example demonstrates the potential for local actors to fill an important void created by political gridlock at the federal level and is consistent with recent scholarship on the ability of cities and metropolitan areas to promote local initiatives and progressive labor market policies.<sup>9,10</sup> Third, the increasingly effective utilization of LEV in the tuckpointing process illustrates how the skills and abilities of masonry restoration workers and contractors led to field innovations difficult to anticipate in more controlled experiments. In detailing this case, we do not suggest that local efforts should displace national safety initiatives. Rather, we seek to document the importance of pragmatic responses to the lassitude of standards development at the federal level by exploring how local adoption of LEV in Chicago can provide lessons to other regions of the U.S. and support for the feasibility of engineering controls in reducing respiratory disease risk among construction workers.

Efforts to document local innovation are important because slow rulemaking in safety and health increases the value of alternative pathways to protect workers from occupational risk. By design, standard setting in occupational safety and health, even in the absence of organized resistance, is painstaking. This is, in part, due to requirements set forth in Section 6(b) of the OSH Act that stipulates a standard-setting process that is more rigorous than that required for most other federal agencies. The

general rulemaking standard for most federal regulation is guided by the Administrative Procedure Act that requires regulations to withstand a challenge of being “arbitrary” or “capricious.” In contrast, OSHA, the Environmental Protection Agency, and the Consumer Financial Protection Bureau are the only three agencies in the federal government that must provide “substantial evidence as a record as a whole” for the adoption of a new standard.

Judicial decisions and legislation subsequent to the enactment of the OSH Act have further delayed the formulation of new regulations. A 1980 Supreme Court ruling established that OSHA must provide quantitative risk assessment for each health Standard (Industrial Union Department, AFL-CIO v. American Petroleum Institute 448 U.S. 607, 639). Subsequent court decisions, including a 1992 decision that struck down an OSHA initiative that would have updated hundreds of Permissible Exposure Limits has further hamstrung OSHA. These decisions reinforced within OSHA the imperative to develop strong evidentiary cases that will withstand the increasing likelihood of legal challenges and judicial review. As part of its assessment, OSHA must evaluate the technological and economic feasibility of proposed standards. This includes a cost-benefit analysis and requires OSHA to make a number of worksite visits that strains OSHA’s scientific and technical staff and limited resources. Still further constraints were placed on OSHA rulemaking in 1996 with the Small Business Regulatory Enforcement Fairness Act (SBREFA). This law requires the creation of special panels when proposed regulations will affect small business (rather broadly defined) that are charged with reviewing proposed standards before a proposed rule is completed and published for public comment. This regulatory environment has allowed interests opposed to new regulation to support contrary research designed to instill sufficient doubt necessary to slow implementation of regulations designed to improve environmental health. Of the 58 OSHA standards promulgated since 1980, only 10 were finalized between 2000 and 2009 and only one was finalized since 2010.<sup>11</sup>

The risks of silica and the means to control it have been well known for over a century.<sup>12,13</sup> Beginning at the turn of the twentieth century and continuing for some years later, there were widespread cases of silicosis among granite workers in Barre, Vermont. For these workers, awareness of the hazard posed by granite dust and the preferred means of control – ventilation – was a primary organizing and subsequent bargaining issue. Another particularly tragic awakening to the silica hazard was the death of hundreds of workers resulting from digging a tunnel through rock containing very high quartz levels in Gauley Bridge, West Virginia in the 1930s. Although the events at Gauley Bridge prompted Congressional hearings and garnered the attention of the first U.S. Secretary of Labor Francis Perkins, federal activity

related to silica was relatively limited and virtually dormant with regard to regulations for most of the twentieth century until passage of the OSH Act.

Even after the passage of the OSH Act, silica exposure in the construction industry remained largely under recognized. Part of this may reflect an understandable tendency to place higher priority on addressing more imminent dangers, such as fatalities from falls and other traumatic events, rather than health hazards that may not result in illness or death for years, or even decades, after exposure. Given the saliency and consequences of traumatic accidents, it is not surprising that OSHA safety inspectors are more likely to be sent to construction sites while industrial hygienists were, and may still be, steered towards “general industry.” Use of OSHA industrial hygienists for health hazard inspections has been less frequent in construction when compared to other heavy industries. The industry itself appears to have remained largely unaware of the silica hazard until the mid to late 1990s and gained prominence in 2000 when *Engineering News Record* – the journal of note for the construction industry – published a feature story on silica titled “The Scourge of Silicosis” (6 November 2000) with a large color photo of a construction worker creating a cloud of dust with a portable masonry saw on the cover. By the first decade of the new millennium, ample research demonstrated that silica exposures were pervasive in construction and that effective engineering controls were available.<sup>14–20</sup>

In 1992, NIOSH Director Dr. J. Donald Millar developed a national program to eradicate silicosis, which he described as “an occupational obscenity.” Joint prevention efforts on the part of OSHA, NIOSH, and the Mine Safety and Health Administration kicked off a national public education campaign in 1996 with the theme – *Silica: It’s not just dust* and NIOSH Alerts were published and disseminated widely. OSHA published its Special Emphasis Program (SEP) for Silica in 1996. This catalyzed increased silica inspections in construction. The results were dramatic: an analysis of OSHA compliance data collected between 1997 and 2002 showed that 24% of the personal air monitoring samples of construction workers exceeded the PEL by three times or more compared to only 13% of samples collected in other industries.<sup>21</sup>

OSHA finally published a comprehensive proposed silica standard in 2013, almost 40 years after NIOSH recommended one and roughly 15 years after more contemporary rule making for silica began. Following the development and review of a SBREFA Draft standard in 2003, a proposed standard languished in review by the Office of Management and Budget (OMB) before publication. The OMB review which began in February of 2011 took over two years despite OMB guidelines that call for a 30-day review period.

## The Chicago case

To understand the adoption of LEV in Chicago, our research team conducted interviews with a former OSHA administrator, union leaders, and contractors in Chicago and reviewed recent documents related to efforts to reduce dust exposure in tuck pointing work. Following interviews, we sent notes from the interviews to each informant to verify the accuracy of interview notes, ask follow-up questions, and request documentation related to the development of dust control.

The adoption of LEV in Chicago occurred in two phases, over a 20-year period beginning in the early 1990s. The first phase was a period of increased awareness of silica risk in construction driven largely by OSHA's release of the 1996 SEP for Silica.<sup>22</sup> The OSHA SEP-targeted industries in which elevated silica exposures were known to exist. This phase spanned much of the 1990s and was characterized by greater OSHA enforcement and attention to silica in construction. In the second phase starting in 2000, local actors, including construction users, local regulators, contractors, and unions responded to the OSHA SEP and the concerns of stakeholders about dust created during tuckpointing.

### *Phase 1: recognition of a silica exposure risk in the masonry industry*

While there was already some activity at the national level with silica and silicosis prevention and awareness in the early 1990s, the introduction of the OSHA SEP for silica was a milestone and catalyst for subsequent activity. According to our interviews, LEV use in construction prior to the 1990s was rare and both federal and local activity encouraging the use of LEV was lacking. Two of our informants independently described masonry restoration at the Clinton Avenue Station, a heavily trafficked downtown Chicago commuter station. Work at this site generated the release of large volumes of dust prompting complaints from office workers coming into the city each morning. The response of local regulators was to reschedule the work to night-time, without any measures to reduce or control worker exposure to dust.

The increase in OSHA compliance activity as a result of the SEP is evidenced by the increase in the number of health inspections involving silica from that period. Within OSHA Region V (Indiana, Minnesota, Michigan, Ohio, Wisconsin, and Illinois), there were five inspections in construction involving personal air monitoring for silica between May 1993 and May 1996; between May 1996 (when the OSHA SEP was published) and May 1999 the number of inspections increased to 77.<sup>1</sup>

<sup>1</sup> Personal communication with C. Shields, July 15, 2013. These numbers were derived by identifying silica samples taken only between those dates, in Region V, Federal Inspections, Substance Code 9010, SIC codes 1500 thru 1799.

The Chicago OSHA area offices utilized the SEP to reduce silica exposure in the construction industry. In addition to scheduled inspections, they initiated training based, in part, on lessons gleaned from inspection data and interactions with contractors. Our OSHA informant believed that the Chicago area offices were exceptionally responsive to the opportunity presented by the SEP, perhaps in part because one of its originators at OSHA headquarters in Washington, D.C. was a former Region V Administrator. In addition, the former Regional administrator and all Area Directors from OSHA offices in the Greater Chicago area were industrial hygienists, and therefore likely aware of the adverse health effects of silica.

OSHA's educational efforts related to silica were directed towards several audiences, including OSHA personnel, occupational health professionals, contractors, unions, and workers. According to our informants, these efforts created awareness of silica risk in construction. For instance, OSHA compliance officers from Illinois attended education seminars in March 1999 that covered silica and lead. In addition, at the May 1999 American Industrial Hygiene Conference and Exposition, an OSHA official presented a Chicago tuck-pointing case at an annual session dedicated to industrial hygiene issues that arise during OSHA inspections. Also around this time, Chicago area offices began meeting with contractors to provide education about silica and the contents of the SEP. These events and awareness raising activity within organized labor at the national level led to increased awareness of the silica hazard in the mid to late 1990s among building trades unions and contractors.

Although the use of LEV was not widespread between 1996 and 2000, there were early adopters. Both union contractors interviewed said they began using LEV in the mid to late 1990s, before it was an industry norm in the Chicago area. One contractor said that his earliest encounters with dust controls were during construction of a federal building downtown and occupied high rises in the mid 1990s. Owner requirements and complaints by residents, respectively, drove the company, one of the largest masonry restoration companies in the Chicago area, to investigate dust control methods. This contractor also noted that the company owner was very forward thinking and that he and the superintendent were former union firefighters, making them sympathetic to the interests of workers. The second contractor, an owner of a smaller business, stated that her company started using LEV in 1997–1998 when they were awarded a contract at the Great Lakes Naval Base north of Chicago. Because the job started in the interior of a building, there were specifications calling for “zero dust emissions.” The company designed its own LEV for the job. She believed that their readiness to respond to the dust control needs of the client helped them

secure the job at the Naval Base and subsequently, at other locations in downtown Chicago.

### **Phase 2: adoption and diffusion of LEV**

The introduction of the SEP in 1996 and the proactive posture of OSHA's Region V office were largely responsible for raising the awareness of silica risk in tuckpointing operations. This was sufficient to prompt one or two contractors to adopt some form of LEV technologies in the late 1990s. However, it was not until around 2000 or later that there was broader adoption of these technologies in the Greater Chicago area resulting from mutually reinforcing activities of local actors and NIOSH-supported research efforts. These groups were motivated by different objectives. For the local union, OSHA, and NIOSH-supported researchers, concern with worker health was the primary driver of the adoption of LEV. In the case of local regulators and owners, the initial motivation was the pressure to reduce nuisance dust that impacted building occupants and community members. In the case of contractors, eagerness to secure work with minimal work stoppages from dust complaints and the desire to participate in cooperative efforts with local unions, especially Tuckpointers Local 52, stimulated the use and experimentation with LEV. Regardless of the motivation, there was a convergence of activity among multiple actors that created a supportive local institutional environment that facilitated the adoption of LEV technologies in the tuckpointing trade.

### **Tuckpointers Local 52**

During the time period studied, Chicago Tuckpointers Local 52 represented tuckpointers in the greater Chicagoland area and played an important role in initiating steps to protect tuckpointers from silica exposure. Notably, Local 52 was one of a few dedicated tuckpointer locals in the country. In most regions of the U.S., tuckpointers were mixed in with bricklayers and other allied crafts. As a result, Tuckpointers Local 52 in Chicago played a distinctive role in bringing attention to occupational silica exposure. Tuckpointers in Chicago had (and continue to have) a specialized apprenticeship program whose instructors incorporated LEV use into skills training. Also, the leadership of Local 52 worked closely with contractors and OSHA in seeking practical methods for protecting workers from silica exposure and was recognized nationally by the Bricklayers Union as a leader for joint labor/management approaches to silica control. In 2004, Local 52 was absorbed into a larger "mega-local" that includes bricklayers and other allied craft, but they retained a separate training fund.

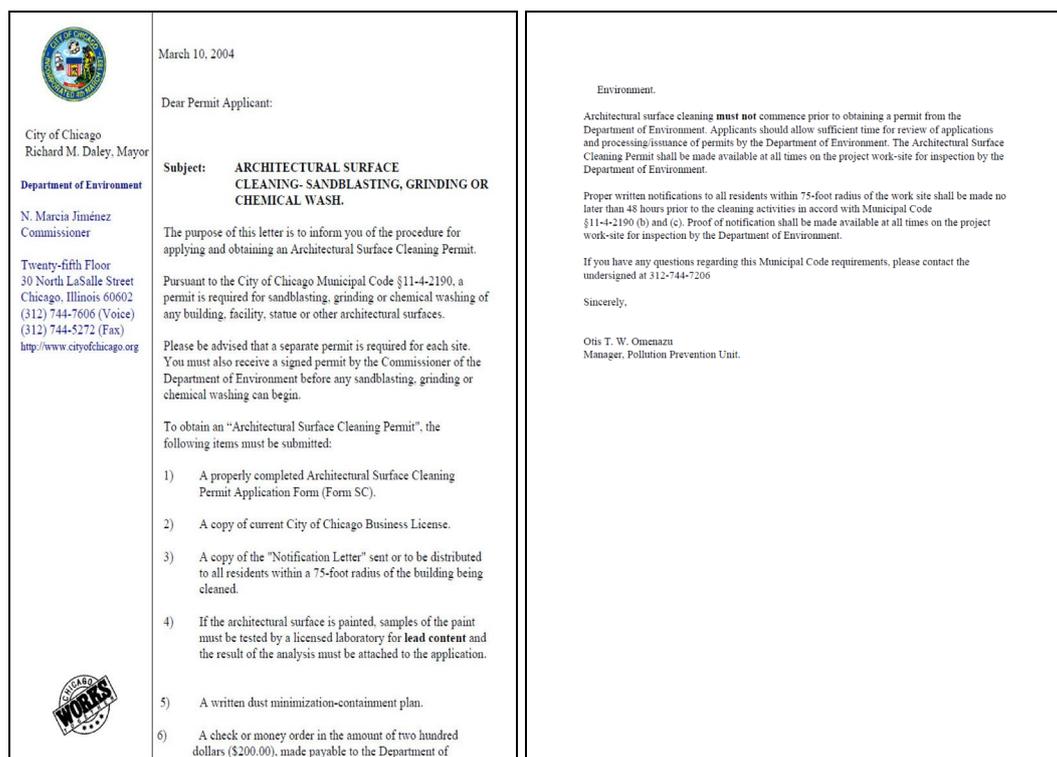
In 2000, a meeting between contractors and Tuckpointers Local 52, with the active involvement of OSHA, resulted in an agreement to develop and implement a respiratory protection program that would be paid out of a joint labor-management promotional fund. The fund was supported by 14

cents per hour payroll contribution by contractors signatory to the local's collective bargaining agreement. Under this arrangement, all workers were to be annually trained, fit tested, and medically evaluated. Contract language mandating the use of respirators and steps to sanction workers for noncompliance were also introduced. This agreement was the result of increased enforcement and educational outreach efforts. At the time of this agreement, the use of LEV, a primary engineering control method, was still not common. The reliance on respirators was in part likely due to the perceived and/or actual inadequacy of some commercially available LEV dust capture systems for tuckpointing. As the deficiencies of LEV became apparent, various groups, including early adopters in the masonry restoration industry, began experimenting with various systems and configurations and in some cases, even developed their own shop modifications to meet the high dust capture demands of tuckpointing in a manner they thought was cost-effective and performed adequately.

### **Local regulators**

Concurrent with activities of Local 52 and OSHA, Chicago ordinances, rules and codes, and large public user requirements began to exert influence on the use of LEV. Concerns about ambient dust exposure to the public at large also prompted the use of control systems for tuck-pointing. A 2004 letter from the Chicago Department of Environmental Protection (DEP) to contractors (Fig. 4) put contractors on notice that a dust minimization plan must be prepared by the contractor and signed off on by both building owners and the contractor when sandblasting, grinding, or chemical washing of architectural surfaces. In order to get a work permit, the dust minimization plan had to be submitted to the city and written notice needed to be provided to building occupants or those likely to be impacted by the work, no later than 48 h prior to the start of work. The permit and notification requirements were enforced through a local ordinance originally promulgated as city environmental regulation, but was later put under the purview of the Chicago Department of Public Health.

Also, beginning in 1996 but with amendments and modifications following in subsequent years (2002, 2007, 2008), the Chicago City Council passed the "Critical Examination Ordinance."<sup>23</sup> This ordinance, created in the interest of public safety, is one of many "façade ordinances" passed in other large U.S. cities in recent decades. The ordinance requires that the facade of buildings of a certain age and height, be regularly inspected by professionals to determine if there is any need for repair. Building owners are required to make any necessary repairs to deficiencies identified during the inspections. Given the large number of older masonry structures in Chicago, this ordinance is thought to have stimulated a great deal of masonry restoration work in high profile, densely populated areas of the city.



**Figure 4 Letter from Chicago DEP regarding permit requirements, 2004.**

Multiple informants stated that the dust-suppression plans mandated by the Chicago municipal code have commonly been met with use of LEV, although the use of LEV was not originally specified. Early awareness of engineering controls was likely influenced by OSHA and occupational health training that emphasized a "hierarchy of controls" with engineering controls like LEV, being required by OSHA to meet permissible exposure limits before employers resort to secondary control measures such as administrative controls and respirators. Beyond this, there were likely other reasons contractors chose to comply with local dust regulations with use of LEV. Contractors may have understood LEV was the best means to address the dust problem, or they believed this was the dust control method preferred by the city or client; or they chose to incorporate work practices being promoted and preferred by the Tuckpointers union. The motivation of early adopters may have also been some combination of all of the above or varied depending on the job and/or the contractor. One contractor interviewed, who was also an early adopter, noted that LEV was simply the most efficient and effective means of complying with the regulations.

### **The local market influence of major construction clients/users**

Another important factor driving the adoption of LEV in Chicago was a large wave of Chicago Public School (CPS) work beginning around 2000 that was subject to job specifications mandating the use of dust-suppression methods.

Though these specifications were aimed at minimizing dust exposure to school employees and students during grinding and other dust generating activities, contractors were still forced to utilize the best technologies and methods to comply with these requirements. And in the event of a dust complaint, CPS specifications required that the work be stopped until the problem was investigated and resolved at the expense of the contractor. This work followed a long period of budgetary constraints and neglect of school buildings that had severely deteriorated. The large infusion of school construction funds concurrent with a workforce and industry more aware of the silica hazards and effective technologies for addressing that hazard was a strong catalyst for change in the way contractors routinely conducted tuckpointing, and resulted in the greater use of dust capture systems going forward.

### **Local contractor innovation and LEV use**

The contractors interviewed showed great initiative. When the need for LEV arose, they began designing, building and adapting existing vacuums to create customized models they viewed as more efficient. One of the contractors interviewed had seen a dust control system at the annual World of Concrete exhibit and used what he saw there to have mechanics build a prototype and in this way arrived at what they currently use. Though not perfect, according to this contractor, personal air monitoring found the systems to be about 80% effective at dust capture. The LEV system they developed is still being used and is supplemented with use of respirators.

### ***The role of research***

As early adopter activity was underway locally in Chicago, on the national level a working group co-chaired by NIOSH and CPWR began a dialogue on engineering control technologies for silica in the mid-90s and began promoting and conducting research specific to tuck pointing in 1999. Among some industrial hygienists, there was concern that the LEV systems used by tuckpointers may not be capable of capturing the very high dust levels generated by the tuckpointing process. Researchers at NIOSH and CPWR began publishing research related to silica and engineering controls for silica beginning in 2003.<sup>14–20</sup> Research on a variety of LEV systems which involved measurement of silica exposure among tuckpointers using grinders, with and without controls, continued into the current decade. These studies have led to published recommendations for improving LEV design, focusing on grinder shrouds, minimum air flows needed for effective dust capture and ease of use. More recent efforts aimed at promotion of effective LEV systems drew manufacturers into the discussion and work on improving dust capture. This research was enriched by practical lessons learned from workers and contractors with experience using LEV and led to a growing synergy between contractors and researchers seeking to identify commercially available systems that would lead to sufficient silica exposure reductions needed to reduce health risk. For instance, one of the contractors interviewed stated that he received useful information from research available on CPWR's website and from seeing LEV models at a conference (World of Concrete).

### ***Diffusion of LEV for tuckpointing***

Once a small number of contractors began to use LEV, there were a number of factors that facilitated wider adoption. Field use of LEV by contractors in Chicago, driven by local regulators and construction clients, provided a living laboratory where new technologies could be tested and refined. Chicago contractors had experience with LEV and workers and their union had knowledge of how such systems should be used. Such experience and knowledge is invaluable in no small part because the workforce was trained in the use of the same tools and equipment they would use independent of a particular job. Union training programs also included basic safety and health training that typically emphasized a preference for use of LEV over respirator use. Given the high union density of the construction trades in Chicago, the workforce was more stable overall and likely to have greater longevity in the local industry. In short, expertise and work practices travel with the local workforce creating efficiencies that may not exist with a more transient, migratory, and less unionized workforce. These workforce characteristics contribute to the maximization of productivity with the control. The use of LEV as the preferred means of control was further buttressed by more recent web-accessible documents posted on the City's web site after the merger of enforcement by the Department of Public Health with the DEP.

The experience of LEV use in Chicago has contributed to awareness of LEV and likely its use elsewhere. The President of Tuckpointers Local 52 was so impressed by a contractor's early use of LEV that he videotaped a job where it was being used and sent the tape to their union's national office in Washington, D.C. – the International Union of Bricklayers and Allied Crafts. Around this time, the Chicago Construction Safety Council's Annual Safety and Health Conference began featuring panels on silica exposure in construction and included presenters from NIOSH and CPWR, among others, who described cutting edge research on control technology, including LEV for tuckpointing. These conferences brought together organizations from Chicago and nationally where current state-of-the-art information was exchanged and tended to draw a healthy contingent of "on the ground" contractor representatives, largely from the Midwest.

### **Conclusion**

The incorporation of LEV into the tuckpointing trade in Chicago demonstrates the value and potential of local agents and regulations in promoting occupational safety and health. In some cases, local change agents use national resources and initiatives that for political and legal reasons may not have taken hold or have limited utility at the national level. Too often political gridlock impedes occupational health rulemaking at the national level despite strong evidence that standards are needed and viable control technologies are available. In such cases, the development and facilitation of local action around occupational and environmental safety and health offers not only a means to expand protection to workers locally, but also may contribute to progress at the national level. With regard to the latter outcome, the opportunity for employers and workers to demonstrate the viability of engineering solutions at the local level undermines arguments that they are too expensive, cumbersome, or otherwise impractical. Such experience is valuable when advocating for improved standards at the national level, convincing industry practitioners in other regions of the U.S. that these claims are unfounded, and providing OSHA compliance officers leverage when trying to enforce engineering control requirements with non-compliant contractors.

We explored the specific ways diverse groups of stakeholders and events in Chicago converged around reducing silica exposure in the tuckpointing trades, but many of the lessons highlighted in this case study are more general. First, in many instances, the interests of worker and public health converge which opens up the potential for use of regulatory levers beyond OSHA. Whereas, pre-emption rules limit the ability of local governments to develop new occupational health standards, this is not the case when localities are enforcing federal environmental standards. In Philadelphia, for instance, city agencies since 2012 have been in discussions with local stakeholders about how safe work practices on construction sites can contribute to the city's effort to maintain clean air standards. Second,

construction clients and users are an important influence on local work practices. Identifying and working with large construction users who are motivated by multiple stakeholders to address environmental contaminants may catalyze occupational health innovations in construction. This, in turn, may lead to further refinements that both lower the costs and increase the efficiency of the innovation. Finally, local unions and contractors can utilize the support of national research resources and regulatory programs to promote and support early adoption of innovations in occupational safety and health. Evidence of success at the local level that may contribute to the broader diffusion of these innovations regionally and nationally.

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We appreciate the assistance of the many contributors to our research, including the contractors who provided crucial insights into the reasons why local contractors did or did not institute controls during the roughly 20-year period we studied.

Charles Shields, formerly an OSHA area director, assistant regional administrator and Training Institute Director prior to retiring, provided us with a detailed timeline of OSHA's and NIOSH's work during the period of study, as well as documents that reflected the changes in construction practices and also served as a liaison to other OSHA personnel who were able to provide additional information.

Mike Hunt, who served as the Pointing, Caulking and Cleaning (PCC) Coordinator for the Bricklayers Administrative District Council #1 of Illinois prior to retiring, met with us over several years, referred us to contractors and discussed in detail his experiences and understanding of the Chicago tuck pointing industry including when he first saw the emergence of dust controls in his trade. He also introduced us to workers who participated in surveys and discussion groups giving us insight into the practices of contractors that went beyond that of those we interviewed. He, Safety Director of the International Masonry Institute, who worked closely with the researchers over many years and came out of the tuck-pointing trade, assisted in facilitating these discussions. Jerry Scarano, Vice President of the International Union of Bricklayers and Allied Craft Workers, introduced us to union leadership at the local level that opened the doors necessary to find the people with the experience and knowledge of tuck pointing to complete our research.

Tom Villanova, former President of the Chicago and Cook County Building and Construction Trades Council, provided us with a broad overview of the construction industry in Chicago as well as how the political landscape has changed over the past several decades. He also introduced us to other important union officials in the city and identified individuals in government who might be key research informants.

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## Notes on contributors

Marc Weinstein is Clinical Professor of Management at the Chapman Graduate School of Business at Florida International University (FIU) where he teaches in the traditional and online Master of Science programs in Human Resource Management. His research focuses on occupational safety and health and employee wellness. His research has been widely published and he has received grant support for his research from a variety of private foundations and government agencies. He is Director of College Relations for the Greater Miami Society for Human Resource Management and is on the Executive Committee of the United Faculty of Florida at FIU. He received his PhD from the Sloan School of Management, Massachusetts Institute of Technology, and has had previous appointments at Case Western Reserve University and the University of Oregon.

Pam Susi has served as the Exposure Assessment Program Director for CPWR – the Center for Construction Research and Training – since 1993. With NIOSH, she co-chaired an Engineering Controls Work Group between 1993 and 2015 which has as its mission the identification, evaluation, and promotion of engineering controls for construction. She has co-authored 30 publications. Prior to being an industrial hygienist, she was a union carpenter and has remained a member of the United Brotherhood of Carpenters since 1981.

Mark Goldberg retired in 2011 as an associate professor in Environmental and Occupational Health Sciences from the City University of New York School of Public Health. For over 20 years, he conducted research in chemical exposures to construction workers, focusing on asbestos, lead, and silica. Prior to his faculty position at CUNY, he worked as an industrial hygienist with the Occupational Safety and Health Administration and with the New York City Department of Health. Most recently, he has been spending his time entertaining his 20-month old grandson.

## ORCID

Marc Weinstein  <http://orcid.org/0000-0001-9034-6782>

Pam Susi  <http://orcid.org/0000-0003-2084-0165>

Mark Goldberg  <http://orcid.org/0000-0002-5256-4508>

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