EVALUATION OF THE IMPACT OF A MANDATORY SAFETY TRAINING REGULATION ON OCCUPATIONAL INJURY AND FATALITY RATES AMONG U.S. STONE, SAND AND GRAVEL MINERS

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A Dissertation submitted to

The Faculty of the
School of Public Health and Health Services
of The George Washington University
in partial fulfillment of the requirements
for the degree of Doctor of Public Health

January 31, 2009

Dissertation directed by

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The School of Public Health and Health Services of The George Washington University certifies that Celeste Monforton has passed the Final Examination for the degree of Doctor of Public Health as of August 5, 2008. This is the final and approved form of the dissertation.

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Dedication

In memory of Tyler Kahle, 19, and Craig Bagley, 28 who died at a surface mine in Nome, Alaska on July 17, 2007, and the 259 deceased workers who appear in this analysis only as fatality statistics. May I never forget that there are faces and families behind the statistics.

Acknowledgments

My pursuit of a doctorate in public health would not have been possible without the encouragement, advice and support of many colleagues and friends. At the top of the list is

David Michaels, PhD, MPH, who assured me that achieving this goal was possible. Since July 2002, has been encouraging me all the way for which I am most sincerely grateful. Special thanks also to Richard Windsor, PhD, MS, MPH who introduced me to the principles of program evaluation for public health practice and assisted me greatly in defining my research question and study design. His textbook *Evaluation of Health Promotion, Health Education, and Disease Prevention Programs* (McGraw Hill, 2004) was a valuable resource for me; to Dante Verme, PhD, MS, a wonderful professor in the classroom, and a most welcome sight when my SAS® ARIMA outputs had my brain twisted in knots; and to Hala Nsouli, MPH and GWU doctoral candidate in epidemiology and biostatistics who was my excellent SAS® programming coach.

Many individuals have shared their experience and wisdom with me about worker health and safety policies, practices, history and politics, but a few deserve special mention: Tom Bethell, Eula Bingham, Dick Clapp, John Froines, Pete Galvin, Carol Jones, Rocky McKinney, Andrea Hricko, Peter Infante, Jerry Markowitz, Davitt McAteer, Tony Oppegard, Joe Pavlovich, Anthony Robbins, David Rosner, Greg Wagner, and Ken Ward. This six-year endeavor would not have been possible without the love of my husband Jim Steenhagen and his steadfast patience and support.

Abstract of Dissertation

Evaluation of the Impact of a Mandatory Safety Training Regulation on Occupational Injury and Fatality Rates among U.S. Stone, Sand and Gravel Miners

Background: In 1999, the U.S. Mine Safety and Health Administration (MSHA) issued a worker safety and health training regulation for stone, sand and gravel mining operations. Previously, these workplaces had been exempt from federal requirements for mandatory safety training due to a congressional appropriations rider that had been in place since 1980.

Methods: An intervention time-series design was used to evaluate changes in quarterly injury and fatality rates from 1995 to 2006 at 7,998 mines affected by MSHA's Part 46 training regulation. The analyses involved 14 non-stationary data series of quarterly incidence data, with covariates for year-round versus seasonal operations, ownership, relevant standard industrial classification codes, and injury severity categories.

Results: The overall crude rate of fatal injuries per 200,000 employee hours declined 33 percent, from 0.025 in the pre-regulatory intervention period to 0.017 in the post-intervention period. Similarly, overall crude rate of injuries declined 19 percent, but these time series were dependent on time (i.e., non-stationary), and the reductions were merely consistent with temporal trends. Graphical plots of all but one of the 48-quarter data series provided no evidence of an intervention effect that could be attributed to MSHA's Part 46 training regulation. Rates of permanently-disabling injuries, however, declined markedly after the regulation took effect. Regression analyses indicated that miners working in the post-Part 46 period had 41 percent less risk of suffering a

permanently disabling injury than in the period before the regulation took effect (RR=0.591 (95% C.I. = 0.529 - 0.661)).

Conclusion: There is little evidence that MSHA's Part 46 safety and health training regulation had an impact on overall fatality rates, or rates related to lost-time, restricted-duty or medical-treatment-only injuries. While it is plausible that there is a causal relationship between the regulatory intervention and the statistically significant decline in the rate of permanently-disabling injuries, inconsistency in the results preclude attributing the observed outcome to the intervention. Further analysis of data is needed.

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GLOSSARY OF TERMS

Accident. Accident is defined in the Mine Act as a "mine explosion, mine ignition, mine fire, or mine inundation, or injury to, or death of, any person."

Appropriations Rider. Legislative language inserted into the funding bill for a federal Department or Agency which typically instructs an entity to take some particular action or prohibits some activity.

CFR. Code of Federal Regulations.

Coal Act. Federal Coal Mine Health and Safety Act of 1969.

Compliance Officers or Compliance Safety and Health Officers (CSHO). The term used by the OSHA to describe the federal employees who serve as authorized representatives of the Secretary for the purpose of conducting safety and health inspections at workplaces.

Days Away from Work. Used interchangeably for the phrase "Lost Work Days."

Department of Labor (DOL). U.S. Department of Labor.

Effective Date. The date when the regulation takes effect and is legally enforceable by a mine inspector.

Exempt Mines. Exempt mines refers to the approximate 10,000 surface mining operations which were exempt from MSHA's Part 48 training regulations.

H&S. An acronym for "health and safety"; used interchangeably with "safety and health"

Intermittent Operations. A seasonal-type mining operation; an establishment that did not report employee hours consistently in each quarter. Reported employee hours in a minimum of eight quarters in both the pre- and post-intervention periods.

Lost Work Days. "The number of workdays, consecutive or not, that the employee would have worked but could not because of the occupational injury or illnesses…[but] should not include the day of the injury or onset of the illness." (MSHA, 1986)

Mine Act. Federal Mine Safety and Health Act of 1977.

Mine Inspector. The term used by the Mine Safety and Health Administration to describe the federal employees who serve as authorized representatives of the Secretary for the purpose of conducting safety and health inspections at mining operations.

Mine Safety and Health Administration (MSHA). The federal agency established by the Federal Mine Safety and Health Act of 1977; an agency within the U.S. Department of Labor.

MSHA's Appropriations Rider. Beginning in fiscal year 1980, the following language was inserted in the funding bill for the U.S. Department of Labor, and was affixed to MSHA's appropriations until fiscal year 2000. "MSHA is specifically prohibited from using appropriated funds to carry out Section 115 of the Federal Mine Safety and Health Act of 1977 or to carry out that portion of Section 104(g)(1) of such Act relating to the enforcement of any training requirements with respect to shell dredging, or with respect to any sand, gravel, surface stone, surface clay, colloidal phosphate, or surface limestone mine."

National Institute for Occupational Safety and Health (NIOSH). The federal agency established by the Occupational Safety and Health Act of 1970; an agency within the U.S. Department of Health and Human Services.

Occupational Safety and Health Administration (OSHA). The federal agency established by the Occupational Safety and Health Act of 1970; an agency within the U.S. Department of Labor.

OSH Act. Occupational Safety and Health Act of 1970.

Overall Injury Rates. Refers to the rate of non-fatal injuries per 200,000 employee hours; it includes injuries which required medical-treatment, days of restricted-duty and lost workdays, but does not include injuries requiring only first-aid treatment.

Part 46. Refers to the MSHA regulations which took affect on October 1, 2000 and applied to surface stone, sand and gravel and other surface non-metal mining operations exempt from MSHA's Part 48 training requirements.

Part 48. Part 48 refers to the MSHA regulations on mandatory safety and health training for mine workers which took affect in 1979. The regulations require mine operators to develop and submit to MSHA annual training plans, with requirements for 40 hours of safety and health instruction for new miners, 8 hours of annual training for experienced miners, new task training, among other things. The legal reference for the Part 48 rules are 30 CFR Part 48 "Training and Retraining of Miners" (Parts 48.1 through Part 48.32)

Permanently-Disabling Injuries. Injuries resulting in permanent total disability or permanent partial disability.

Pre-Intervention Period: January 1, 1995 through September 30, 2000.

Post-Intervention Period: October 1, 2000 through December 30, 2006.

Seasonal Mining Operation. See "Intermittent."

Section 104(g)(1). Refers to the Section in the Mine Act which gives an MSHA inspector the authority to remove a miner from the worksite if the inspector determines that the miner has not received the required safety and health training.

Section 115. Refers to the Section of the Mine Act on mandatory safety and health training for miners, including 24 hours of training for new surface miners, 8 hours of annual refresher training for all miners, and training on new tasks, and provisions for wage compensation for time spent in training, recordkeeping requirements, and monetary penalties for falsification of training records.

Serious Injuries. Injuries classified as permanently-disabling, lost-work time, or restricted-duty; does not include medical-treatment only injuries.

Serious and Substantial. When a violation of a mandatory federal mine safety or health standard is deemed by a mine inspector to be "of such a nature as could significantly and substantially contribute to the cause and effect of a mine safety or health hazard and if such violation to be caused by an unwarrantable failure of the mine operator to comply with such mandatory health or safety standard" it is designated as a serious and substantial violation under Section 104(d)(1) of the Mine Act.

Standard Industrial Classification (SIC). Industry codes developed by the U.S. Bureau of Labor Statistics (BLS).

Training Rider. Refers to the language attached to the appropriations bill for the U.S. Department of Labor, beginning in fiscal year 1980 and included through fiscal year 2000, which specifically prohibited MSHA from "using appropriated funds to carry out Section 115 of the Federal Mine Safety and Health Act of 1977 or to carry out that portion of Section 104(g)(1) of such Act relating to the enforcement of any training

requirements with respect to shell dredging, or with respect to any sand, gravel, surface stone, surface clay, colloidal phosphate, or surface limestone mine." Sections 104(g)(1) and 115 are provisions of the Mine Act concerning safety and health training for mine workers.

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

The effectiveness of occupational safety and health regulation on preventing work-related injuries, illnesses and fatalities among U.S. workers continues to be a source of debate. Although incidents rates have declined over the decades since the Occupational Safety and Health Administration and the Mine Safety and Health Administration were established, the empirical evidence is limited; there are too few, well-designed studies measuring intervention effectiveness ((Van der Molen et al., 2007; NIOSH, 2006; Goldenhar and Schulte, 1996; NIOSH, 1996). Advocates of more protective workplace injury and illness prevention policies are obliged to rely on an outdated and inadequate science base. Opponents of government intervention in the market place and in employer-employee relationships offer alternative assessments of regulatory effectiveness using methods and theory from the law and economics discipline (Hahn and Malik, 2004; Kniesner and Leeth, 2003; Ruffenbach, 2002; Viscusi and Gayer, 2002; Magat et al., 1988; Hughes et al., 1986; Viscusi, 1983). The aim of this dissertation is to add to the public health literature with an evaluation of the impact of a federal mine safety training regulations on injury and fatality rates in a large population of U.S. surface mining operations.

When the public thinks of dangerous occupations, mining jobs often tops their list probably because of high-profile entrapments and explosions involving underground coal miners. (Van Riper, 2007; Warrick, 2006; U.S. Senate, 2006). A less known fact is that workers in other types of mining operations face even higher risks of injury and disability than their counterparts working in underground coal mines. At surface dimension stone

quarries, for example, the occupational injury incidence rate in 2006 was 5.0 per 100 full-time workers, more than twice the rate for surface bituminous coal miners (BLS, 2006b). Every year, thousands of miners receive medical treatment for work-related injuries, more than one-third of which require missing at least one day from work (BLS, 2006b; BLS, 2005b; MSHA, 2006; MSHA, 2005).

The public health consequences of work-related injuries are significant, in both economic and social costs (Waehrer, et al., 2007; Boden, 2005; Boden et al., 2001; Leigh, et al., 2004a; Dembe, 2001; Boden and Galizzi, 1999; Miller and Galbraith, 1995).

In additional to injury rates, fatalities in the mining industry are also higher than most other industries, with a rate of 25.6 fatalities per 100,000 workers, compared to rates of 17.6 and 11.0 in the transportation and warehousing industry and the construction industry, respectively (BLS, 2006a). Although traditional considered "safer" than the coal-mining sector, in 1995 the number of fatalities at non-coal mining operations surpassed those at coal mines, and that trend continued until 2001 (MSHA, 2004). From 1993 to 2006, 412 workers have died from fatal injuries received while working at surface aggregate mines (MSHA, 1999b; MSHA, 2007a) and thousands more have suffered severe injuries (MSHA, 1999b). In 2005, the rate of fatalities at surface stone and sand and gravel operations was 0.218 per 100 workers, compared to a fatality rate of 0.018 for surface coal miners (MSHA, 2005).

In 2006, the United States aggregates industry produced 2.95 billion metric tons of crushed stone, sand and gravel, valued at about $21 billion (USGS, 2007b; NSSGA, 2007). More than 110,000 men and women worked in the aggregates industry, mining limestone, dolomite, and granite that is eventually used to build roads and highways,

residential and commercial construction, and public works projects (NSSGA, 2007; USGS, 1999; MII, 2007).

1.2 Federal Mine Safety and Health Regulation in the U.S.

The federal agency responsible for enforcing mine safety and health laws in the United States is the Mine Safety and Health Administration (MSHA). MSHA is a sister agency to the better known Occupational Safety and Health Administration (OSHA), and was established by the Federal Coal Mine Health and Safety Act of 1969 (Coal Act), as amended by the Federal Mine Safety and Health Act of 1977 (Mine Act). The law transferred all standard setting, inspection, accident investigation and training authorities for all coal, metal and non-metal mining worksites, from the U.S. Department of Interior's Mine Enforcement Safety Administration to the U.S. Department of Labor (U.S. Senate, 1977; U.S. House 1977).

As directed by the Federal Mine Safety and Health Act of 1977 (Mine Act), MSHA issued new regulations in 1979 for mandatory safety and health training for any worker employed at a mine (30 CFR Part 48). The regulations required all new miners to receive at least 24 hours of safety training before they could be assigned work tasks, and stipulated topics such as "introduction to the work environment," "transportation and communication systems," "escape and emergency evacuation," "ground control," "electrical hazards," and "statutory rights." MSHA's Part 48 regulations also required experienced miners to receive at least 8 hours of refresher safety and health training each year, and specialized task training when assigned new responsibilities or to work on different equipment. The rule covered miners employed at underground and surface coal

mines, underground metallic mines, surface pits and stone quarries, and any operations were workers were employed in extraction of non-liquid minerals (Mine Act).

Shortly before the rules were set to take affect, representatives of non-metal surface mining operations petitioned Congress for an exemption from the training requirements. These employers argued that their operations, which were surface stone quarries, gravel pits and the like, were substantially different from coal and other mining operations. They made the case that the Part 48 regulations were written from a coal mining perspective, and thus were irrelevant and impractical for their worksites. Members of Congress agreed and in fiscal year 1980, the following language was inserted in MSHA's annual appropriations:

> MSHA is specifically prohibited from using appropriated funds to carry out Section 115 of the Federal Mine Safety and Health Act of 1977 or to carry out that portion of Section 104(g)(1) of such Act relating to the enforcement of any training requirements with respect to shell dredging, or with respect to any sand, gravel, surface stone, surface clay, colloidal phosphate, or surface limestone mine.

Congressional appropriators inserted this language in the agency's appropriation for 19 consecutive years. The surface mines at which safety training regulations could not be enforced by federal mine inspectors, came to be known as the "exempt" mines.

Beginning in 1993, the number of miners suffering fatal injuries at the "exempt" mines started to surpass the number of fatalities at coal mining operations. From 1993 through 1997, 200 miners died from fatal injuries while working at non-coal surface mining operations, and 82 percent (163 deaths) of them occurred at the "exempt" operations. The multi-year spike in fatalities and a front-page story in *USA Today* about

deaths at these operations, (Drinkard, 1998) created an opportunity for MSHA's Assistant Secretary, congressional appropriators and representatives of the "exempt" mines to negotiate a plan to remove the long-standing rider. Congressional leaders endorsed a plan to retire the rider, if MSHA worked closely with the affected mine operators to develop new a training regulation more appropriate for this sector of the mining industry. By congressional directive, the new training rules had to be issued by September 30, 1999 (Public Law 105-277) and mine operators were given one full year to come into compliance with them. During the one-year period between the time the Part 46 regulation was issued and its effective date, mine operators were encouraged to develop and implement their training plans, and were provided assistance through federal and state outreach programs.

The new mandatory safety and health training regulations, known as Part 46, took affect on October 1, 2000. The rules apply to about 10,400 mines, more than 73 percent of all U.S. mining operations, and affect 110,000 workers.

1.3 Research Objectives

In 1996, the National Institute for Occupational Safety and Health (NIOSH) issued a comprehensive framework for research on occupational safety and health. The National Occupational Research Agenda (NORA) was a private-public collaborative effort, involving 500 organizations and persons, providing input toward the development of a systematic research agenda (MMWR, 1996; NIOSH, 1996). The final agenda identified three broad research categories: Disease and Injury, Work Environment and

Workforce, and Research Tools and Approaches. Twenty-one research priorities accompanied the three broad categories.

Within the category Research Tools and Approaches, one of the eight priority topic areas was Intervention Effectiveness Research. The NORA authors indicated that despite measurable improvements in workplace injury and fatality rates, few occupational health and safety interventions had been evaluated. They noted: "many interventions are undertaken based on faith and expert judgment without convincing evidence that these approaches are effective (NIOSH, 1996). The authors acknowledged that intervention research is a relatively new field which requires expertise drawn from a variety of disciplines which have not traditionally been involved in research on workplace safety and health issues. The NORA identified numerous research opportunities to assess intervention effectiveness, including the implementation of new regulations and policy changes.

On the 10th anniversary of the NORA, NIOSH issued *The Team Document: Ten Years of Leadership Advancing the National Occupational Research Agenda*, summarizing progress on achieving the goals of the research framework (NIOSH, 2006). The report reiterated that intervention effectiveness research was "an underutilized tool when NORA began," and indicated that over the 10-year period, only limited contributions were made to the science base. The authors offered seven suggestions for future directions, repeating several research areas identified in the original 1996 agenda, such as "encourage the conduct of policy intervention studies" was one of the group's key recommendations (NIOSH, 2006).

The aim of this study is to evaluate the impact of MSHA's Part 46 safety training regulations on injury and fatality rates among the affected population of mine workers. In the years preceding the implementation of MSHA's mandatory training rule, there was evidence suggesting that mining operations that were "exempt" from the Mine Act's mandatory safety training requirements experienced a disproportionately higher number of fatalities compared to the non-exempt mines. Among surface mining operations, for example, the "exempt" mines experienced 82 percent of the work-related fatalities, but accounted for only 64 percent of the employments hours at surface operations (MSHA, 1999a). Moreover, MSHA indicated that miners employed at these operations suffered a higher proportion of non-fatal injuries, and estimate that injury cases could be reduced by 557 incidents following implementation of the Part 46 rules (MSHA, 1999a; MSHA, 1999b).

The study is a problem-based scientific inquiry designed to yield valid and useful new knowledge that will inform public health practice (GWU/SPHHS 2007). Specifically, the study involves a policy intervention effectiveness analysis and evaluation of the changes in fatality and injury rates in the period of time before the regulation took affect (January 1, 1995 through September 30, 2000) and after the regulation was implemented and enforced (October 1, 2000 through December 30, 2006). The subject specifically addresses one of the priority research areas recommended by NIOSH in the NORA, and adds to the scientific evidence base.

This study will evaluate the impact of the regulatory intervention of the Part 46 training rules on fatality and injury rates at the affected mines. The research questions are: