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Is the Societal burden of fatal occupational injury different among NORA industry sectors?

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Abstract

Problem—Since the implementation of the Occupational Safety and Health Act, safety and health in the work environment has seen marked improvement. Although these improvements are laudable, workplace hazards continue to plague the American worker. Understanding the economic burden of fatalities by industry sector is important to setting broad occupational safety and health research priorities. Cost estimates provide additional information about how fatal injuries affect society and hence can improve injury prevention program planning, policy analysis, evaluation, and advocacy.

Method—This study estimated the total, mean, and median societal costs by worker and case characteristic in 2003–2006 for the industry sectors identified in the National Institute for Occupational Safety and Health National Occupational Research Agenda (NORA). Analyses were conducted with restricted access to the Bureau of Labor Statistics Census of Fatal Occupational Injuries data. These data exclude military personnel, decedents with unknown age or sex, and fatalities occurring in New York City. Societal costs were estimated using the cost-of-illness approach, which combines direct and indirect costs to yield an overall cost of a fatal occupational injury.

Results—During this period, the cost of the 22,197 fatal occupational injuries exceeded \$21 billion. The mean and median costs of these fatalities were \$960,000 and \$944,000 respectively. Total societal costs by NORA sector ranged from a high of \$5.8 billion in Services to a low of \$530 million in Healthcare and Social Assistance with mean costs ranging from the nearly \$800,000 in Agriculture, Forestry, and Fishing to almost \$1.1 million in Mining.

Discussion—The societal costs—total, mean, and median costs—of case and worker characteristics for occupational fatal injuries varied within each NORA sector.

Impact on Industry—To have the greatest societal impact, these costs can be used to target resources for public and private sector research by industry.

Keywords

fatal occupational injury; occupational injury cost; NORA; burden of injury; occupational safety

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1. Introduction

Mankind has been concerned with the safety and well-being of workers for more than 2,000 years. Most of the earliest accounts focused predominately on health rather than safety issues. With the advent of the industrial revolution, the interest on the relationship between injury and the work environment began to intensify. By 1936, the Walsh-Healey Act provided protection of workers in a broad sense—no work could be performed if the establishment was unsanitary, hazardous, or was dangerous to the worker for federal contracts of over \$10,000 (Walsh-Healey, 1936).

The passage of the Occupational Safety and Health (OSH) Act (Public Law 91–596) in 1970 provided a systematic national approach “to assure so far as possible every working man and woman in the Nation safe and healthful working conditions (29 U.S. Code [USC] 671).” The Act devised a three-pronged program to meet the mandate to improve safety and health in general industry and construction (OSH Act, 1970). The Department of Labor housed two of these prongs, the Occupational Safety and Health Administration (OSHA) and the Bureau of Labor Statistics (BLS). OSHA was created as the regulatory arm equipped to promulgate and enforce standards. The BLS was named as the statistical arm to determine the number of occupational injuries and illnesses on a routine basis. The final prong, the National Institute for Occupational Safety and Health (NIOSH), was established to help assure safe and healthful working conditions by providing research, information, education, and training in the field of occupational safety and health (NIOSH, 2012)

To accomplish the charge, NIOSH provides national and world leadership to prevent work-related illness, injury, disability, and death by gathering information, conducting scientific research, and translating the knowledge gained into products and services, including scientific information products, training videos, and recommendations for improving safety and health in the workplace.

In 1996 NIOSH engaged in an innovative public-private partnership to establish priorities for occupational safety and health research both at NIOSH and throughout the country—the National Occupational Research Agenda (NORA). During its first decade, NORA advanced safety and health knowledge in 21 scientific areas by emphasizing priority-driven research. The program entered its second decade in 2006 by focusing national research on the problems of highest relevance to workers, employers and occupational safety and health practitioners in the major industrial sectors to better move research to practice within workplaces (NIOSH, 2009).

The number of work-related injuries and illnesses are collected and published annually by BLS as required under the OSH Act. During the first decade of NORA, the total number and rate per 100 full-time workers of occupational injuries declined by 33% and 39% respectively. In the second decade of NORA through 2010, the number of occupational injuries dropped from 3.9 million in 2006 to 2.9 million in 2010—a 25% decline. During this same time period, the number of days away from work cases for injuries and illnesses were 1.2 million in 2006 and dropped 200,000 by 2010. Moreover, the BLS Census of Fatal Occupational Injuries (CFOI) reported that the number of fatalities declined by 6% during

the first decade of NORA and has declined by 22% since the advent of the second decade (BLS, 2011).

However, measures of the human loss—frequency, rate, and severity—describe only a portion of the burden to society. Section (2)(a) of the OSH Act highlighted the need for societal costs by stating “The Congress finds that personal injuries and illnesses arising out of work situations impose a substantial burden upon, and are a hindrance to, interstate commerce in terms of lost production, wage loss, medical expenses, and disability compensation payments.” (OSH Act, 1970). This paper provides the first step in identifying the burden to society by deriving the societal costs of fatal occupational injuries occurring in the U.S. This measure of economic loss or burden adds a valuable dimension to targeting efforts as well as providing input for evaluating the effectiveness of investments in prevention efforts. This study concentrates on determining the societal burden in those areas of NIOSH focus, the NORA industry sectors, and examining the similarities and differences of these costs across the sectors. Presentation of the societal costs of fatal occupational injury by case and demographic characteristics within each NORA industry sector allows policy makers to systematically examine current and potential programs using standard economic measures.

2. Methods

For this study, the costs of fatal occupational injuries were estimated using a model developed by the Division of Safety Research within NIOSH (Biddle, 2004, 2009; Biddle & Keane, 2011). This model uses the cost-of-illness method to estimate the effect on the U.S. Gross Domestic Product (GDP) of a workplace fatality by combining direct and indirect costs to yield an overall societal cost of a fatal occupational injury. The direct and indirect costs of each fatal occupational injury were derived independently and then summed for each demographic and case characteristic.

The nominal value for medical costs in 1998 dollars of \$11,276, obtained from the Detailed Claims Information (DCI) database from National Council on Compensation Insurance (Detailed Claims Information, 1992–1995), was the single direct cost used in the study. The dollar value was adjusted to 2006 dollars using the Consumer Price Index-Medical Care Index (BLS, 2009a).

The indirect lifetime cost of an individual fatal occupational injury was derived by calculating the present value of lost household production and future earnings of that worker summed from the year of death until that decedent would have reached age 67, accounting for the probability of survival were it not for the premature death—the human capital approach. The earnings component of the cost model consists of four parts: base wage; fringe benefits; economy-wide productivity growth; and life-cycle wage growth. The base wage of the decedent at the time of death was derived from the BLS Occupational Employment Statistics, a Federal-State cooperative semi-annual establishment survey, which produces state-based occupational wages (BLS, 2009b). Because this survey does not provide wage data by age, the wage value was adjusted to account for the age of the decedent at the time of death using a NIOSH developed algorithm (Biddle & Keane, 2011).

The base wage was also adjusted to include the value of employee fringe benefits using BLS Employer Cost for Employee Benefits data from the National Compensation Survey Program (BLS, 2009c). The BLS Employment Cost Index (BLS, 2009d) was used to estimate the amount that wages increased in concert with the growth of the U.S. economy as a whole. To account for the final component of wage growth, estimates of the life-cycle growth – the salary growth due to individual worker experience – were used to adjust the base wage. The non-market losses or loss of household production were derived from time-diary data captured in the National Human Activity Pattern Survey study commissioned by the Environmental Protection Agency (Expectancy Data, 2000).

Mathematically the indirect cost calculation is represented as follows:

$$PVF = \sum_{n=y}^{67} P_{y, q, s}(n) \left[Y_{s, j}(n) + Y_s^h(n) \right] * (1+g)^{n-y} / (1+r)^{n-y}$$

where:

PVF	present discounted value of loss per person due to an individual fatal occupational injury
$P_{y,q,s}(n)$	probability that a person of age y, race q, and sex s will survive to age n
q	race of the individual decedent
s	sex of the individual decedent
n	age if the individual had survived
$Y_{s, j}(n)$	median annual compensation of an employed person of sex s, specific occupation j, and age n (includes median annual earnings, benefits, and wage growth adjustments)
j	specific occupation of individual at death
$Y_s^h(n)$	mean annual imputed value of household production h of a person of sex s, and age n
g	earnings growth rate attributable to overall productivity
y	age of the individual at death
r	real discount rate (3%)

A hypothetical example calculation would best illustrate how this model operates. In this hypothetical example, the decedent is a 44 year-old white male carpenter in construction who was injured in Alabama and died in 2004. The calculations are illustrated for each component of the formula for the first two iterations (for ages 44 and 45) following the fatality below. The second iteration would be repeated 22 more times or until the decedent would have reached age 67.

$P_{y,q,s}(n)$	0.99675 in first year calculation; 0.99647 in second year calculation
n	44 years old in the first year calculation; 45 years old in the second year calculation.
$Y_{s, j}(n)$	$[(\$27,090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1))] +$ $[(\$27,090 * 1.2176005 / 0.937176) * (1.000897 * 0.1925 * 1.007183)]$ in the first year calculation; $[(\$27,090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1)) * (1.001794 * 0.986751)] +$ $[(\$27,090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1)) * (1.001794 * 0.986751) * (0.20425 * 1.014367)]$ in the second year calculation.
$Y_s^h(n)$	$[(\$10,278.40 / 0.828138) * (1.000897)]$ in the first year calculation; $[(\$10,716.4 / 0.828138) * (1.001794)]$ in the second year calculation

$(1+g)^{n-y}$	1.000897 and 1.007183 in first year calculation; 1.001794 and 1.014367 in second year calculation.
$(1+r)^{n-y}$	1.03^{1-1} in the first year calculation; 1.03^{2-1} in the second year calculation

The following are used in calculations for the first year only.

\$11,276 Medical cost with an adjustment of 0.7807159 from the Medical Care Consumer Product Index.

For the first year estimate, the wage, benefit, and household production values are summed and multiplied by the probability of survival (determined by the age of the person at the time of death), which is then discounted at a 3% rate and added to the fixed medical cost adjusted for medical inflation. In the second year the wage, benefit, and household production values are summed and multiplied by the probability of survival (determined by the age of the person one year from the time of death), which is then discounted at a 3% rate for the second year estimate. In subsequent years, the process remains the same except for adjusting the discount rate superscript to the iteration calculation number minus 1.

The first year calculation of

$$(0.99675 * (((27090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1)))) + ((27090 * 1.2176005 / 0.937176) * (0.1925 * 1.007183)) + ((10278.4 / 0.828138) * (1.000897))) / 1.030 + (11276 / 0.7807159)$$

yields a total of \$81,314.16.

The second year calculation of

$$(0.99647 * (((27090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1))) * (1.001794 * 0.986751)) + (((27090 * 1.2176005 / 0.937176) * (1.000897 * (((1.008627 - 1) / 2) + 1))) * (1.001794 * 0.986751) * (0.20425 * 1.014367)) + ((10716.4 / 0.828138) * (1.001794))) / 1.031$$

yields a total of \$66,350.05.

The resulting two year PVF for this specific hypothetical fatal occupational injury is \$81,314.16+\$66,350.05 or \$147,664.21.

Fatal injury data for each decedent was obtained with restricted access to the BLS Census of Fatal Occupational Injuries (CFOI) program data for 2003–2006 (BLS, 2009e). This census compiles data from 50 States and the District of Columbia using multiple sources, such as death certificates, medical examiner records, newspaper accounts, and workers' compensation claims for decedents of any age as long as the death was a work-related fatal injury occurring in the U.S. Decedents less than 16 years of age, of unknown age or sex, identified as members of the U.S. military, and fatalities occurring in New York City were not included in the cost calculations in this study. Because of these constraints, the number of occupational fatal injuries may not match those published by BLS. Additionally, the views expressed here do not necessarily reflect the views of the BLS.

Societal costs were calculated for case and demographic characteristics of decedents employed in the NIOSH NORA Sectors at the time of their death. These industry sector groups were defined in 2006 following the North American Industry Classification System (NAICS) which identifies 20 sectors. NIOSH aggregated industries into eight broad defined Sectors in Table 1.

The event or exposure in the CFOI describes the manner in which the injury was produced or inflicted and is coded based on the Occupational Injury and Illness Classification System (OIICS) Manual (BLS, 2007). The 2000 Standard Occupational Classification (SOC) system was used by BLS to classify decedents into occupational categories (Office of Management and Budget, 2000).

3. Results

During the 4-year period from 2003 to 2006, there were over 22,197 occupational fatal injuries, with a total societal cost of over \$21 billion. The overall mean and median costs for these fatalities were \$960,000 and \$944,000 respectively (Table 2). The majority of the decedents were male (20,536 males compared to 1,661 females) but females had a higher mean cost (\$950,000 for males compared to \$1,085,000 for females). Over 80% of the decedents were White, which also carried the highest mean and median values. Nearly half of the decedents (47%) were between 35 and 54 years old at the time of death, while their total societal cost contributed over half (57%) of the total loss. Occupations in the Natural resources, construction, and maintenance occupational group had the highest number of fatalities and total costs, but the occupational group of Management, professional and related occupations had the highest mean and median values. The leading event or exposure was Transportation accidents, accounting for 40% of the total fatalities and 40% of the associated total societal cost. However, they carried the fourth highest mean cost and the third highest median cost.

Tables 3 through 10 present the number and costs of selected case and demographic characteristics for each NORA industry sector.

In the Agriculture, Forestry and Fishing sector, the total cost of all fatal occupational injuries was just over \$2 billion, with mean and median costs of \$777,000 and \$710,000 respectively (Table 3). The highest mean value was associated with the occupational group with the least number of fatalities—Production, transport, and material moving occupational group. The occupational group of Natural resources, construction, and maintenance accounted for over 40% of the fatalities but had the lowest mean value, which was 70% of the highest mean value.

Falls (31%), Transportation accidents (27%), and Contact with objects and equipment (20%) events or exposures accounted for the majority of the \$5.1 billion total cost of occupational fatal injuries in the Construction sector (Table 4). However, Assaults and violent acts carried the highest mean cost of any event or exposure category at \$1.2 million per fatality. Males comprised the overwhelming majority (98%) of the total burden of the fatalities in the Construction sector, but experienced a mean and median cost slightly lower than females.

The Management, professional and related occupations occupational group had the largest number of occupational fatalities as well as the largest proportion (77%) of the overall societal cost in the Healthcare and Social Assistance sector (Table 5). This group also experienced the highest mean and median costs approaching double the magnitude of the smallest costs in Service occupations. The overwhelming majority of the total costs were

found in two event or exposure categories—Transportation accidents (53%) and Assaults and violent acts (27%).

In the Manufacturing sector, the occupational group of Production, transport, and material moving workers comprised nearly 70% of all fatalities, had the highest total societal cost, but had the second lowest mean and median costs (Table 6). The overwhelming majority of fatal injuries were White and male, which also represented the highest proportion of total costs (90% and 85% respectively).

Transportation accidents had the largest number of fatal occupational injuries in the Mining sector, followed closely by Contact with objects and equipment (Table 7). These two event or exposure categories also had the highest total societal cost (accounting for nearly 70% of all costs in this sector). The event or exposure category with the lowest total cost, Falls, had the highest mean cost of \$1.1 million. The remaining event or exposure categories presented had mean and median costs that exceeded \$1 million.

The Services sector experienced the highest number of fatal occupational injuries in the occupational group of Service and related occupations, which also had the largest total societal costs (Table 8). However, the occupational group of Management, professional and related occupations had the highest mean and median costs. The mean cost of this group was substantially higher than other groups—nearly 1-1/2 times the lowest mean cost and 1-1/3 times the next highest mean cost. Five of the 7 event or exposure categories had a mean cost of greater than \$1 million.

Transportation accidents had the highest total cost of fatal occupational injuries as well as the largest number of fatalities in the Transportation, Warehousing, and Utilities sector, accounting for nearly 3/4 of the total count and burden within the sector (Table 9). Females had a mean cost 20% higher than males and a median cost 12% higher than males. Decedents with a reported race category of “Other” had a mean cost higher than any other race category—7% higher than White and 16% higher than Black.

The Wholesale and Retail Trade sector saw nearly half of the occupational fatal injuries occurring to those workers in the occupational group of Sales and office occupations (Table 10). The Management, professional and related occupations occupational group had a mean cost nearly double the cost of the next highest occupation group, Natural resources, construction, and maintenance group. Event or exposure categories had a mean cost of under \$1 million. The highest mean cost (Fires and explosions) was nearly 1-1/2 times the lowest cost (Bodily reaction and exertion).

4. Discussion

The societal toll of fatal occupational injury is substantial—over \$21 billion in this 4 year period, but it was not evenly allocated among NORA industry sectors. The total societal costs ranged from a low of \$530 million in Healthcare and Social Assistance to a high of \$5.8 billion in Services. To a large extent the variation is due to the number of fatalities occurring in each of the NORA industry sectors; Services had the highest number of fatalities while Healthcare and Social Assistance had the lowest. However, it should be

noted that the distribution of the number and total costs of these fatalities by NORA industry sector are not identical. The Agriculture, Forestry, and Fishing sector constituted 12% of the occupational fatal injuries, but only 10% of the total costs. Conversely, the Construction sector accounted for 22% of the number of fatal injuries but a larger portion, 24%, of the total burden. The varying mean costs across industry sectors contributed substantially to creating these differing proportions of the total societal burden.

The range of mean societal costs was considerable, with Mining almost 1-1/2 times greater than the industry sector with the lowest mean value—Agriculture, Forestry, and Fishing (Table 11). Four of the industry sectors' mean costs were less than \$1 million and four were more than \$1 million per fatal injury, but only two industry sectors had median costs above \$1 million. All but two industry sectors, Mining and Transportation, Warehousing, and Utilities, had median costs that were lower than their mean costs. Mining and Construction sectors had the highest median costs. Mining and Construction also had the smallest difference between mean and median costs—pointing to a more normal distribution of those individual average costs. The difference between the mean and median costs across all industry sectors ranged from less than 1% (Mining sector) to just over 9% in the Healthcare and Social Assistance and Agriculture, Forestry, and Fishing sectors.

There are many similarities in the cost estimate patterns by demographic and case characteristics among the NORA industry sectors, which suggest that research in these areas would be most beneficial to all industry sectors. The pattern for the burden by sex was consistent throughout the industries—males had the highest number of fatalities and the greatest total cost, while females had the highest mean and median costs. There was a single exception—Healthcare and Social Assistance—where females had not only the highest mean and median costs, but also the highest total cost while males had the highest number of fatalities.

In all industry sectors, the White race category had the largest number of fatalities and the highest total costs. In four of the sectors, Construction, Manufacturing, Services, and Wholesale and Retail Trade, the White race category also had the highest mean and median costs. Other sector mean and median highs were in the race category “Other” except Mining where the highest mean and median costs were found in the Black race category.

The highest burden in all of the cost categories was found in the middle age groups—25–34 years, 35–44 years, and 45–54 years—with the greatest burden falling into the 35–44 age group. In five of the industry sectors, the total, mean and median cost was highest in the 35–44 years age category. Furthermore, the mean cost was highest for the 35–44 years category in all but one industry sector, Transportation, Warehousing, and Utilities, where the highest mean was found in the younger age category of 25–34 years old. The older age group, 45–54 years, had the highest total and median costs in Agriculture, Forestry, and Fishing as well as the highest total cost in Healthcare and Social Assistance.

Although similarities among the industry sectors can be found in the case characteristic of event or exposure, they are far less pervasive than among worker demographic characteristics. Only three of the NORA sectors—Services; Transportation, Warehousing,

and Utilities; and Wholesale and Retail Trade—had sufficient fatalities in all seven event or exposure categories to meet publication criteria. Transportation accidents had the highest total societal cost in six of the eight NORA industry sectors, and in the remaining two sectors the category had the second highest total cost. Although the mean cost of an event or exposure varied among industry sectors, Assaults and Violent Acts were highest in 50% of the industry sectors.

Understanding that the magnitude of the costs derived by this model is largely dependent on the compensation and age of the decedent helps to explain some of the variation in these cost estimates. More specifically, a greater societal burden is estimated when the decedent was employed in an occupation that provides higher compensation and was in the middle age groups at the time of death. Worker compensation is driven by the worker occupation, the industry, and state in which they were employed. Therefore, to fully understand why specific case and worker characteristics produce higher or lower societal costs, more detailed estimates and analysis than provided in this paper must be derived. However, some generalized information can be gleaned from the age of the decedent. Among event or exposure categories the cost of Assaults and Violent Acts has the highest mean cost in the Construction and Services sectors. In each of these sectors, half of the decedents were in the age groups (25–34 and 35–44) with the highest mean cost. This can be compared to the Agriculture, Forestry, and Fishing sector where only 19% were in those age categories and the mean cost for Assaults and Violent Acts was the second lowest cost.

As the characteristics and conditions of the workplace changes, the societal costs of fatal injuries will respond accordingly. Fatalities are associated with the characteristics of the job and the characteristics of the worker. In 2010, the Bureau of Labor Statistics reported that a “rising labor force participation among older persons is likely part of a long-term pattern that began in the mid-1990s”. The participation rate for those 55 and older has jumped from 29 percent in May, 2009 to 40 percent in February, 2010. Furthermore, currently those over 65 years old had a fatality rate of 11.9 per 100,000 full-time equivalent workers in 2010—3 times higher than the rate for all workers— and those aged 55–64 years old had the second highest rate of 4.7 (BLS, 2012). In addition, changes in the overall health status of our aging workforce, such as increased rates of diabetes and obesity, will most likely increase the risk occupational fatal injuries. As the workforce becomes older, the societal impact generated from this model should be reduced as the formula stops aggregating burden at age 67. However, the change in societal costs will depend on the wages of the occupations in which they are employed at the time of their death. If a worker retires from a full-time highly paid occupation but continues working in a part-time minimum wage occupation, the reduction will be much less than if they remained in their occupation throughout their life. Changes in the work environment will also impact the burden. Currently, the high growth rates for employment are found in the Health Care and Services sectors—both having higher mean costs than most sectors. However, these sectors have traditionally had lower fatality rates and counts. Ultimately, the changes in the burden of fatal occupational injury derived by this model will be determined by the compensation and age associated with the decedent.

The cost model used in this study produced a conservative estimate for the societal costs of fatal occupational injuries. Moreover, these estimates are not exact; they are approximations

based on many factors and are subject to limitations of the model specification and limitations associated with the data inputs. Cost estimates presented are limited as compensation data frequently underestimates the value of youth and other working minority groups. The model does not provide a mechanism to identify changes in career, less than full-time employment, or compensation for multiple job holders. Additionally, the model does not provide a comprehensive cost of occupational fatalities as only a single direct cost category is included in the calculations.

5. Summary

In general, cost estimates provide additional information about how injuries affect society. They represent income that is not received and medical expenses incurred because of fatal injuries and the effect on the GDP and other national economic measures in the U.S. These cost estimates can be used to improve occupational injury prevention program planning, policy analysis, evaluation of safety and health interventions, and advocacy for a safer work environment. They can be used to assist targeting resources for research, both in the public and private sector. They can demonstrate the value of the research directions identified through the NORA efforts as measured by the impact on GDP.

This study demonstrates that not only do industry sectors vary by worker characteristics, industrial function, and safety and health risks, but they vary by the economic losses from occupational fatal injuries. These findings suggest that research efforts to prevent fatal occupational injuries should be identified and conducted within each industry sector independently—as is being done in the NORA process. The study points to areas, such as those with the highest mean costs or total costs, which should be examined more closely to determine where research would best focus on the problems of today's workplaces. Many broad research directions would remain the same as identified by the NORA activity, but those with a greater burden can be highlighted for more immediate targeting. For example, across all industry sectors transportation events have the highest total burden. As a result, it can be suggested that motor vehicle research is needed to assess the effects of electronic devices or information systems in the vehicle on driver attention to the driving task and the risk or occurrence of motor vehicle crashes. In the Services industry, mean costs suggest that assessing the effects of long or irregular hours of work, long hours of driving, or fatigue/sleepiness on motor vehicle crashes, particularly in worker populations such as emergency responders and sales workers should be conducted. Within the Mining sector, researchers should focus on developing activity-specific engineering and process controls in the Oil and Gas industry to limit air contaminant release from process equipment and site environments to prevent exposures to chemical hazards during well servicing operations. Finally, in the Construction sector, research exploring methods to encourage workers to use fall-protection equipment could assist in reducing the overall cost of fatal occupational injury by reducing or eliminating those incidents. Deriving the cost of fatal occupational injury at more detailed levels of case characteristics, such as the types of motor vehicle crashes and who are the perpetrators of assaults and violent acts within industry sectors, would provide more information on where focusing research would reduce the greatest burden, both in human and economic measures.

Biography

Elyce Anne Biddle holds graduate degrees in Economics and Occupational Safety and Health. Currently she serves as Senior Research Economist at the Office of Mine Safety and Health Research at the National Institute for Occupational Safety and Health. Prior to that appointment, she was an Economist at the Bureau of Labor Statistics in the Office of Compensation and Working Conditions. Her research interests include the societal costs of occupational injury, the economic evaluation of safety and health interventions, business decision making, and occupational safety and health surveillance systems.

References

- Biddle E. Economic Cost of Fatal Occupational Injuries in the United States, 1980–1997. *Contemporary Economic Policy*. 2004; 22(3):370–381.
- Biddle, E. The Cost of Fatal Injuries to Civilian Workers in the US, 1992–2001. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS; 2009.
- Biddle, E.; Keane, P. The Economic Burden of Occupational Injuries to Civilian Workers in the United States, 1992–2002. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS; 2011.
- BLS. Occupational Injury and Illness Classification System Manual. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2007. (<http://www.bls.gov/iif/oshhoics.htm>. Accessed June 2009)
- BLS. Consumer Price Index—Medical Care Index 2003–2006. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Prices and Living Conditions; 2009a. (<http://www.bls.gov/cpi>. Accessed on June 2009)
- BLS. Occupational Employment Statistics. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Employment and Unemployment Statistics; 2009b. (<http://www.bls.gov/oes>. Accessed on April 2009)
- BLS. National Compensation Survey – Benefits. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2009c. (<http://www.bls.gov/ncs/ebs/>. Date accessed April 2009)
- BLS. Employment Cost Index. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2009d. (<http://www.bls.gov/eci>. Date accessed June 2009)
- BLS. Injuries, Illnesses, and Fatalities. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2009e. (<http://www.bls.gov/eci>. Date accessed June 2009)
- BLS. Injuries, Illnesses, and Fatalities. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2011. (<http://www.bls.gov/eci>. Date accessed September 2011)
- BLS. Injuries, Illnesses, and Fatalities. Washington, DC: U.S. Department of Labor, Bureau of Labor Statistics, Office of Compensation and Working Conditions; 2012. (<http://www.bls.gov/eci>. Date accessed June 2012)
- Expectancy Data. Shawnee Mission. Kansas: Expectancy Data; 2000. The dollar value of a day: 1998 dollar valuation.
- NIOSH. Delivering on the Nation’s Investment in Worker Safety and Health. Washington, DC: National Institute for Occupational; 2009. DHHS (NIOSH) Publication No. 2008–144
- NIOSH. About NIOSH. Washington, DC: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2012. (<http://www.cdc.gov/niosh/about.html>. Data accessed March 2012)

Occupational Safety and Health Act of 1970. Public Law No. 91-596, S.2193, 84 Stat. 1590. 1970
Office of Management and Budget. Standard Occupational Classification Manual. Washington, D.C:
Office of Management and Budget; 2000.
Walsh-Healey Public Contracts Act of 1936. Public Law No. 74-846, 49 Stat. 2036. 1936

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Table 1NAICS¹ Codes of Industries Included in the NIOSH NORA Sectors.

NORA Sector	NAICS Codes ¹
Agriculture, Forestry, and Fishing	11
Construction	23
Healthcare and Social Assistance	62
Manufacturing	31–33
Mining	21
Services	51–56, 61, 71–72, 81 and 92
Transportation, Warehousing, and Utilities	48–49 and 22
Wholesale and Retail Trade	42 and 44–45

¹ <http://www.census.gov/eos/www/naics/>.

Table 2

Number and Societal Costs of Fatal Occupational Injury by Case and Demographic Characteristics in the United States, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	22,197	\$21,316	\$960	\$944
Sex				
Male	20,536	19,513	950	936
Female	1,661	1,803	1,085	1,018
Race of Decedent				
White	18,347	17,840	972	962
Black	2,160	1,865	864	852
Other*	1,690	1,610	953	907
Age of Decedent				
16–19	480	400	834	789
20–24	1,576	1,627	1,033	971
25–34	3,897	4,832	1,240	1,165
35–44	5,066	6,502	1,284	1,189
45–54	5,384	5,624	1,045	953
55–64	3,548	2,105	593	545
65+	2,246	225	100	85
SOC Occupation Groups[†]				
Management, professional and related occupation	3,630	4,155	1,145	1,161
Service	2,609	2,365	907	844
Sales and office occupations	1,686	1,431	849	825
Natural resources, construction, and maintenance	7,250	7,111	981	993
Production, transport, and material moving	6,984	6,221	891	916
Event or Exposure[†]				
Contact with objects and equipment	3,827	3,569	933	924
Falls	3,014	2,663	884	907
Bodily reaction and exertion	45	40	891	847
Exposure to harmful substances or environments	1,931	2,070	1,072	1,039
Transportation accidents	9,548	9,228	967	957
Fires and explosions	700	700	1,000	1,004
Assaults and violent acts	3,115	3,030	973	887

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 3

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Agriculture, Forestry, and Fishing Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	2,713	\$2,107	\$777	\$710
Sex				
Male	2,610	1,996	765	703
Female	103	111	1,079	955
Race of Decedent				
White	2,434	1,896	779	704
Black	108	76	704	712
Other*	171	136	792	769
Age of Decedent				
16–19	74	57	777	672
20–24	139	132	951	785
25–34	258	309	1,197	1,015
35–44	438	569	1,299	1,047
45–54	530	631	1,190	1,069
55–64	471	316	671	569
65+	803	93	116	106
SOC Occupation Groups[†]				
Management, professional and related occupation	1,350	1,086	804	403
Service	–	–	–	–
Sales and office occupations	–	–	–	–
Natural resources, construction, and maintenance	1,126	785	697	723
Production, transport, and material moving	188	185	983	1,030
Event or Exposure[†]				
Contact with objects and equipment	827	651	788	725
Falls	120	69	572	368
Bodily reaction and exertion	–	–	–	–
Exposure to harmful substances or environments	178	151	848	735
Transportation accidents	1,330	1,040	782	716
Fires and explosions	–	–	–	–
Assaults and violent acts	198	150	758	690

Dashes indicate that data do not meet publication criteria.

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 4

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Construction Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	4,864	\$5,113	\$1,051	\$1,045
Sex				
Male	4,786	5,025	1,050	1,043
Female	78	88	1,133	1,082
Race of Decedent				
White	4,088	4,368	1,069	1,068
Black	360	318	883	886
Other*	416	427	1,026	988
Age of Decedent				
16–19	134	119	891	885
20–24	472	507	1,075	1,032
25–34	1,029	1,297	1,261	1,190
35–44	1,194	1,570	1,315	1,238
45–54	1,127	1,199	1,064	996
55–64	646	394	610	580
65+	262	26	98	78
SOC Occupation Groups[†]				
Management, professional and related occupation	329	483	1,470	1,636
Service	42	29	682	727
Sales and office occupations	26	26	1,013	1,064
Natural resources, construction, and maintenance	4,050	4,203	1,038	1,039
Production, transport, and material moving	414	370	893	981
Event or Exposure[†]				
Contact with objects and equipment	952	1,005	1,055	1,009
Falls	1,582	1,602	1,013	1,029
Bodily reaction and exertion	–	–	–	–
Exposure to harmful substances or environments	700	811	1,159	1,131
Transportation accidents	1,352	1,379	1,020	1,021
Fires and explosions	–	–	–	–
Assaults and violent acts	140	167	1,195	1,172

Dashes indicate that data do not meet publication criteria.

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 5

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Healthcare and Social Assistance Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	502	\$530	\$1,056	\$967
Sex				
Male	265	261	986	900
Female	237	269	1,133	1,075
Race of Decedent				
White	413	436	1,056	993
Black	65	62	954	822
Other*	24	32	1,324	927
Age of Decedent				
16–19	9	8	899	860
20–24	25	29	1,157	1,100
25–34	73	101	1,378	1,236
35–44	106	159	1,502	1,433
45–54	155	172	1,107	950
55–64	89	58	654	556
65+	45	3	75	62
SOC Occupation Groups[†]				
Management, professional and related occupation	341	405	1,188	1,098
Service	55	31	572	641
Sales and office occupations	29	25	850	909
Natural resources, construction, and maintenance	14	12	864	839
Production, transport, and material moving	61	55	897	822
Event or Exposure[†]				
Contact with objects and equipment	–	–	–	–
Falls	49	25	516	511
Bodily reaction and exertion	–	–	–	–
Exposure to harmful substances or environments	54	63	1,167	1,069
Transportation accidents	255	280	1,099	1,011
Fires and explosions	–	–	–	–
Assaults and violent acts	123	143	1,162	1,071

Dashes indicate that data do not meet publication criteria.

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 6

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Manufacturing Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	1,718	\$1,665	\$969	\$950
Sex				
Male	1,611	1,535	953	938
Female	107	130	1,219	1,125
Race of Decedent				
White	1,420	1,408	992	970
Black	185	153	827	830
Other*	113	104	920	915
Age of Decedent				
16–19	37	30	811	762
20–24	112	113	1,007	955
25–34	264	313	1,184	1,103
35–44	424	523	1,234	1,140
45–54	478	498	1,041	940
55–64	304	180	592	563
65+	99	9	93	74
SOC Occupation Groups[†]				
Management, professional and related occupation	167	254	1,519	1,590
Service	29	14	482	528
Sales and office occupations	65	68	1,040	1,011
Natural resources, construction, and maintenance	323	333	1,030	1,056
Production, transport, and material moving	1,131	994	879	900
Event or Exposure[†]				
Contact with objects and equipment	580	548	944	930
Falls	189	156	828	857
Bodily reaction and exertion	–	–	–	–
Exposure to harmful substances or environments	163	173	1,061	1,027
Transportation accidents	491	489	996	963
Fires and explosions	134	130	967	963
Assaults and violent acts	149	162	1,089	997

Dashes indicate that data do not meet publication criteria.

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 7

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Mining Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	644	\$700	\$1,087	\$1,095
Sex				
Male	637	689	1,082	1,093
Female	7	11	1,572	1,432
Race of Decedent				
White	599	653	1,091	1,096
Black	19	24	1,264	1,169
Other*	26	23	884	899
Age of Decedent				
16–19	20	17	862	859
20–24	73	79	1,087	1,066
25–34	144	182	1,264	1,192
35–44	152	198	1,299	1,221
45–54	158	175	1,107	1,054
55–64	74	46	627	589
65+	23	3	123	79
SOC Occupation Groups[†]				
Management, professional and related occupation	–	–	–	–
Service	–	–	–	–
Sales and office occupations	–	–	–	–
Natural resources, construction, and maintenance	449	489	1,088	1,126
Production, transport, and material moving	155	145	933	931
Event or Exposure[†]				
Contact with objects and equipment	214	231	1,080	1,101
Falls	44	49	1,114	1,112
Bodily reaction and exertion	–	–	–	–
Exposure to harmful substances or environments	50	54	1,071	1,090
Transportation accidents	232	251	1,081	1,094
Fires and explosions	93	100	1,076	1,065
Assaults and violent acts	–	–	–	–

Dashes indicate that data do not meet publication criteria.

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 8

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Services Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	5,777	\$5,775	\$1,000	\$939
Sex				
Male	5,063	4,995	987	926
Female	714	780	1,092	1,008
Race of Decedent				
White	4,678	4,763	1,018	971
Black	675	591	876	839
Other*	424	420	992	903
Age of Decedent				
16–19	130	107	827	758
20–24	466	478	1,026	929
25–34	1,150	1,464	1,273	1,177
35–44	1,350	1,779	1,318	1,218
45–54	1,321	1,391	1,053	940
55–64	860	510	593	516
65+	500	46	91	69
SOC Occupation Groups[†]				
Management, professional and related occupation	1,240	1,594	1,286	1,268
Service	2,360	2,187	927	859
Sales and office occupations	359	322	898	881
Natural resources, construction, and maintenance	792	766	968	1,022
Production, transport, and material moving	1,016	896	882	859
Event or Exposure[†]				
Contact with objects and equipment	619	571	922	931
Falls	675	514	761	772
Bodily reaction and exertion	18	18	1,024	902
Exposure to harmful substances or environments	515	524	1,017	962
Transportation accidents	2,344	2,457	1,048	984
Fires and explosions	173	174	1,007	1,052
Assaults and violent acts	1,429	1,513	1,059	970

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 9

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Transportation, Warehousing, and Utilities Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	3,704	\$3,496	\$944	\$974
Sex				
Male	3,526	3,298	935	969
Female	178	198	1,113	1,085
Race of Decedent				
White	2,968	2,821	950	984
Black	502	438	872	908
Other*	234	237	1,015	1,045
Age of Decedent				
16–19	17	14	843	793
20–24	126	140	1,111	1,073
25–34	593	739	1,247	1,197
35–44	910	1,129	1,240	1,189
45–54	1,067	1,043	978	946
55–64	733	406	554	542
65+	258	25	97	71
SOC Occupation Groups[†]				
Management, professional and related occupation	66	101	1,530	1,575
Service	31	28	907	773
Sales and office occupations	113	104	916	835
Natural resources, construction, and maintenance	256	296	1,156	1,192
Production, transport, and material moving	3,238	2,968	916	959
Event or Exposure[†]				
Contact with objects and equipment	350	314	896	930
Falls	157	116	739	726
Bodily reaction and exertion	6	6	941	909
Exposure to harmful substances or environments	171	203	1,188	1,193
Transportation accidents	2,697	2,569	952	996
Fires and explosions	47	52	1,105	1,076
Assaults and violent acts	275	237	861	807

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 10

Number and Societal Costs of U.S. Fatal Occupational Injury by Case and Demographic Characteristics in the NORA Wholesale and Retail Trade Sector, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	2,244	\$1,901	\$847	\$830
Sex				
Male	2,010	1,689	840	822
Female	234	212	906	927
Race of Decedent				
White	1,721	1,472	855	842
Black	244	202	828	823
Other*	279	228	815	777
Age of Decedent				
16–19	58	46	785	746
20–24	160	146	910	835
25–34	384	426	1,110	1,051
35–44	484	566	1,170	1,101
45–54	538	507	942	878
55–64	367	190	519	484
65+	253	20	80	64
SOC Occupation Groups[†]				
Management, professional and related occupation	96	162	1,683	1,644
Service	45	26	572	625
Sales and office occupations	1,088	881	810	787
Natural resources, construction, and maintenance	237	225	950	996
Production, transport, and material moving	777	606	780	826
Event or Exposure[†]				
Contact with objects and equipment	267	235	880	852
Falls	192	126	658	617
Bodily reaction and exertion	6	4	654	674
Exposure to harmful substances or environments	97	88	907	827
Transportation accidents	839	756	900	890
Fires and explosions	58	53	917	870
Assaults and violent acts	784	638	813	784

* This category includes all other races, such as American Indian and Asian, as well as unknown or missing races.

[†] Numbers are not reported for “unknown” or “not classified” categories.

Table 11

Number and Societal Costs of U.S. Fatal Occupational Injury by NORA Industry Sectors, 2003–2006.

Characteristic	Number of Fatalities	Costs (2006 Dollars)		
		Total (millions)	Mean (1,000's)	Median (1,000's)
All Fatal Injuries	22,197	\$21,316	\$960	\$944
NORA Industry Sector				
Services	5,777	5,775	1,000	939
Construction	4,864	5,113	1,051	1,045
Transportation, Warehousing, and Utilities	3,704	3,496	944	974
Agriculture, Forestry, and Fishing	2,713	2,107	777	710
Wholesale and Retail Trade	2,244	1,901	847	830
Manufacturing	1,718	1,665	969	950
Mining	644	700	1,087	1,095
Healthcare and Social Assistance	502	530	1,056	967
Unclassified	31	28	910	955