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The Social and Economic Impact of Work-Related Cancers Among Maintenance-Of-Way Employees

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Abstract

Thousands of railroad maintenance-of-way (MOW) workers develop cancer from their work.

Objective: This study calculates the social and economic burdens of cancer borne by MOW workers.

Methods: Economic calculations are derived from the literature and also from a survey of 4,800 MOW respondents, 155 in-depth interviews, and two focus groups.

Results: This one health problem alone costs at least $226 million to $305 million over the course of cancer cases currently diagnosed among MOW workers.

Conclusion: When a worker has cancer, beyond pain and suffering, there are often financial burdens that affect families, railroad companies, insurers, communities, and taxpayers as well as the injured workers.

Keywords: Cancer, Maintenance-of-Way Railroad Workers, Occupational Safety and Health, Economic Impact, Social Impact

Introduction

Among the many health risks associated with track work, maintenance-of-way employees die of cancers before age 65 at rates approaching double that of the U.S. male population in general. Apart from negative quality of life impacts and their physical, mental and emotional toll, these diseases also impose significant financial burdens upon affected individuals and families, railroad companies, insurers, communities, and taxpayers. The following work calculates the estimated value of these economic and social burdens. The ubiquity of these workplace health hazards and their resulting costs merit serious, sustained attention by all stakeholders. The recognition of these direct and indirect costs will hopefully encourage enhanced efforts to improve safety and mitigate or eliminate preventable work-related health hazards.

Thousands of railroad Maintenance-Of-Way (MOW) workers develop cancer from their work. This one health issue alone costs at least $226 million to $305 million over the course of those cancer cases currently diagnosed. What follows is a study of MOW workers - their illnesses and the suffering and burdens they endure. While the health impact is clearly the most serious, the focus of this paper is the social and economic impacts. When a worker has cancer, beyond pain and suffering, there are often financial burdens that affect families, railroad companies, insurers, communities, and taxpayers as well as injured workers. These burdens include not only direct medical costs of treatment but also other related expenses like over-the-counter medical devices and medications, caretaking, lower productivity of affected workers, lost work time and thus reduced income and future Social Security benefits, psychological stress on individuals and their families, and a host of other factors discussed herein. The work that follows calculates the burden of cancer borne by thousands of MOW workers and many other groups as well. (These costs are societal and have not been allocated to individual parties or groups of parties because of the complexities of third-party payment and differences across geography. This is especially the case for allocation of burden among employers, private insurers, worker's compensation, and Federal Employers Liability Act-sanctioned legal compensation. Calculations in this paper do not include thousands of MOW retirees, many of whom suffer from cancers -- and according to the survey, at a higher rate than active members -- nor do they include non-represented MOW workers.)

Setting

MOW workers face significant risks to their health and safety on a daily basis. Many suffer from significant life-threatening illnesses, including cancers, related to toxic chemical exposures. Maintaining the track is one of the most dangerous jobs facing railroad workers [1], with many dying in workplace accidents. They face a host of ergonomic risks from their use of high vibration tools and equipment. MOW workers constantly bend, twist, and do heavy lifting, thus putting themselves at high risk of injuring their necks, shoulders, knees, backs, hips, elbows, and wrists. They face high noise levels and uneven surfaces walking on ballast. MOW workers are more likely than the general public, for example, to develop Chronic Obstructive Pulmonary Disease (COPD), kidney disease, back problems, and carpal tunnel syndrome. Cancer is a serious health problem for them, but only one among many.

Methodology

An overall social and economic impact study, of which this is just one of five parts - reviewed COPD, kidney disease, lower back problems, and carpal tunnel syndrome in addition to cancers. The economic and social impacts study itself was part of a larger assessment, funded by the Brotherhood of Maintenance Way Employes (BMWED), that also included research on epidemiological and ergonomic and physical hazards. Institutional Review Board (IRB) approvals came from both Cook County Hospital and the State University of New York-Downstate. To ensure that the identity of all survey participants is legally protected from discovery, a Certificate of Confidentiality issued by the National Institutes of Health (NIH) was obtained. Results of this study contain absolutely no individual or identifiable personal information.

The entire membership of BMWED, both active workers and retirees, was invited to participate in a research survey. Of roughly 39,000 BMWED members invited to participate (35,000 currents and 4,000 retired), approximately 4,800 members responded, coming from all 48 continental states. They responded to the survey on-line, in writing, or orally over the telephone, in either English or Spanish.

To determine the representativeness of survey respondents, they were compared to the national membership of the union based on age, years on the job, gender, region of country, and railroad. In addition, survey respondents were compared to a random sample of non-respondents who later agreed to complete a short (10-question) version of the survey by telephone. Those members who completed the survey were, on average, younger, and had slightly better working conditions than members who did not complete the survey. Survey respondents also tended to be healthier than non-respondents. Therefore, the percent of members who reported injuries and illnesses on the large 2016-2017 BMWED survey would probably be somewhat less than the percent that would have been reported by all BMWED active members or retirees if all had completed the survey, implying that the results reported in this paper are likely conservative (lower) estimates of the prevalence of ill health that would have been seen if all had completed the survey.

In addition, for this social and economic impact study, 155 in-depth interviews and two focus groups provided further worker input. The study also includes an extensive literature review, highlighting both related health issues and their economic and social impact. Calculations for economic and social costs are developed in the narrative of the article and corroborated by survey, interview, and focus group comments. The full report is available on request and contains detailed methodology and cost calculations.

The population responding was 99 percent male. Among those who did responded, 82 percent were Caucasian, 6 percent African American, 6 percent Hispanic, and 2 percent Native American (though 25 percent did not designate their race and four percent of those who did stated a mixed race).

The BMWED represents union workers who build and maintain the tracks, bridges, buildings, and related infrastructure on all Class 1 railroads in the United States. They work on road gang crews covering 300,000 miles railroad track.

Cancer and Maintenance-of-Way Workers

As reflected below, cancer rates for MOW workers are especially high for cancer of the bladder, blood, colon and rectum, esophagus, liver, lung, lymphatic system, kidney, pancreas, prostate, and stomach. More specifically, these workers suffer represent a standardized mortality ratio of 1.79 for cancers overall, but as high as 2.17 for pancreatic cancer and 2.36 for liver cancer [2].

The American Cancer Society specifically links asbestos, radon, soot, silica, diesel exhaust, and radioactive ores to lung cancer; herbicides and radiation to lymphatic and hematopoietic cancer; sunlight to skin and lip cancer; radiation to soft-tissue sarcoma [2]. Diesel exhaust is also associated with bladder and laryngeal cancers, and silica with esophageal cancer [3]. According to another study, “A significant proportion of lung cancers is attributable to occupational carcinogens” [4]. Consistent with these findings, a Finnish study has linked cumulative exposure to chemical agents to cancer in railway traffic supervisors [5].

Soot and tar, as well as untreated and mildly treated mineral oils, are human carcinogens, according to the International Agency for Research on Cancer [6]. Creosote is a probable human carcinogen and associated with skin cancer (as well as with skin burning and lung irritation) (U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, 2006) [7]. Creosote is also known to contain poly-nuclear aromatic hydrocarbons (PAHs), which are known human carcinogens (Rincon Consultants, 2013) [8]. In addition, creosote has been found to

have mutagenic effects in vitro - posing harm to the healthy development of fetuses (U.S. EPA, 2008) [9].

Herbicide exposure, especially a combination of amitrole and phenoxy acids have been shown to be associated with an excess of tumors in Swedish rail workers [10]. The International Agency for Research on Cancer (IARC) identifies glyphosate as a probable carcinogen and 2,4-D as a possible carcinogen (International Agency for Research on Cancer, 2015) [11]. The Center for Food Safety questions the categorization of 2,4-D herbicides as only possible human carcinogens because research has often found it to be associated with non-Hodgkin's lymphoma and over 1,500 formulations of sprays use 2,4-D as the main ingredient (Center for Food Safety, 2015) [12]. Herbicides are applied to tens of thousands of miles of track in the United States, and railroads leave it up to their respective contractors to determine which herbicides they use (Progressive Railroading, 2008) [13].

In addition, chromosome aberrations in the blood have been linked to carcinogens in occupational settings, according to a study focusing on rail workers which found abnormalities in rail workers exposed to complex chemical mixtures transported by train [14].

Over the course of their careers, railroad maintenance-of-way workers encounter many of these hazardous exposures both acutely and cumulatively. Indeed, "Rail workers are among the most likely to be exposed to cancer causing materials and substances in the course of their jobs" [15]. These adverse health outcomes and costs may be avoidable; the American Cancer Society links chemicals, dusts, and radiation exposure at work to cancer, and concludes that, "All cancers of occupational origin are preventable" (American Cancer Society, 2015) [16].

Clearly, to the extent that these serious cancers and related health issues are preventable, there are corresponding cost savings in their mitigation or elimination. Given that the direct and indirect costs for a MOW worker with cancer is $272,000 to $376,000 and given that the total cost of the disease over their time, for those currently diagnosed, is $206 million to $304 million, the potential for cost savings is significant.

An understanding of potentially avoidable economic and social costs of cancers among railroad track workers, should provide coherent and compelling incentive for all stakeholders to invest in greater safety and in mitigating or eliminating preventable contributing causes of cancers in the workplace.

Maintenance-of-way workers develop many types of cancers, often due, at least in part, to their work-life exposures. According to one survey respondent, "I have been to so many funerals of past work mates and every single one was cancer… I believe this will be my lot too."

Economic and Social Impacts of Cancer *[17]*

The economic and social costs of cancer are extremely high, but even more so among MOW workers. Based on a standardized mortality ratio study in 2017, BMWED members are 1.79 times more likely to die of cancer as men aged 18 to 64 generally [2]. And the risk of death is especially high for specific types of cancer:

- ✓ 1.82 for esophageal cancer
- ✓ 2.06 for stomach cancer
- ✓ 1.99 for colorectal cancer
- ✓ 2.36 for liver cancer
- ✓ 2.17 for pancreatic cancer
- ✓ 1.82 for lung cancer
- ✓ 1.93 for prostate cancer
- ✓ 1.75 for kidney cancer
- ✓ 1.95 for bladder cancer
- ✓ 1.88 for Hodgkin's disease
- ✓ 1.96 for leukemia.

Economic Costs of Cancer

National expenditures for cancer care in the United States totaled nearly $125 billion in 2010 and could reach $156 billion by 2020 (National Cancer Institute, 2016) [18]. Some estimates showed an increase between 2010 and 2020 of 39 percent, to $173 billion a year [19]. Preventing cancer is clearly in the economic interest of the nation, as well as in the health interest of its people.

The average costs of cancer, from diagnosis on, vary by type. Most expensive of 13 major types of cancer are pancreatic cancer at $318,000 and brain cancer at $285,000. (See Table 1.) Others range from $77,000 for melanoma, $94,000 for prostate cancer, and $180,000 for lung cancer treatment. (U.S. Department of Health and Human Services, National Cancer Institute, circa 2010) [20]. It is initial treatment and last year of life care, that are most expensive, with continuing care less costly (though this area is showing a growing cost because more and more cancer patients are living longer and because pharmaceutical treatments are becoming costlier).

Site	Initial	Continuing	Last Year of Life	Total in 2010 Dollars	Total in 2016 Dollars
Bladder	$20,960	$4,677	$75,772	$101,409	$111,705
Brain	115,250	9,434	134,244	258,928	285,217
Colorectal	51,812	4,595	85,671	142,078	156,503
Esophagus	79,822	6,450	103,742	190,014	209,306
Head/Neck	39,179	4,001	83,662	126,842	139,720
Kidney	38,374	6,018	78,082	122,474	134,909
Leukemia	36,036	10,249	133,183	179,468	197,689
Lung	60,885	7,591	95,318	163,794	180,424
Lymphoma	60,701	9,337	116,596	186,634	205,583
Melanoma	5,437	1,951	62,436	69,824	76,913
Pancreas	94,092	11,697	113,115	288,728	318,042
Prostate	19,710	3,201	62,242	85,153	93,798
Stomach	78,453	4,282	107,130	189,865	219,056

Source: Centers for Disease Control and Prevention and National Cancer Institute. Some data based on data U.S. Department of Labor, Bureau of Labor Statistics: CPI Inflation Calculator. Available from https://www.bls.gov/data/inflation_calculator.htm. [21].

Table 1: Annualized Mean Net Costs of Care for Men with Cancer - Initial Treatment, Continuing Treatment, and Last Year of Life, 2010 and 2016 Dollars.

For these 13 types of cancer, the simple, unweighted average cost for men for a medical cancer treatment is $179,143, significantly higher than the OSHA estimate of $129,624 (U.S. Department of Labor, OSHA, n.d.) [22]. OSHA's indirect cost estimates for cancer are $142,586. If the same relationship of indirect to direct were applied to the National Cancer Institute estimates, the indirect costs would be $197,077 or $376,220 per cancer patient vs. the OSHA estimate of $272,210.

Indirect Economic Costs of Cancer. Cancer can have a profound impact on the earnings of the patient and the patient's family. A study in the United Kingdom (Wilson, [23]) found that 57 percent of cancer survivors who were working when diagnosed, had to leave their job or change roles as a result of their illness. Annual earnings fell by 40 percent within two years and stayed low. Total family income fell by 20 percent for at least four years. And, in most cases, economic outcomes did not return to their pre-diagnosis levels [24].

Cancer may limit one's employment possibilities thereby also limiting, for many, their access to health insurance. Family caregivers may no longer be able to sustain previous employment or may have increased absenteeism, yet the need for employment may be even greater, not just to provide income but also for health insurance coverage and pharmaceutical costs. Drug costs are rising as new targeted therapies reach the market, with many as much as $9,000, $16,000, or even $30,000 a month or more, and cost sharing for drug therapy for those with insurance is typically 20 percent [25].

Indirect costs are estimated to be at least as much as direct medical costs [25]. Many daily living costs increase with long-term illness and treatment [17]. Out-of-pocket expenses for the patient and his/her family beyond copays include drugs, home care, homemaking, alternative medicines, vitamins and supplements, family care, and travel, including parking and possible accommodations. One study showed higher out-of-pocket costs per cancer patient, both direct and indirect at $5,400 for a three-month time period, in 1992 dollars, or $9,238 in 2016 dollars. Of this, $2,433 per month (or $4,240 in 2016 dollars), or nearly half, was from lost wages (Stommel, Given, Given, 2003) [26]. This suggests an annual out-of-pocket expenditure for cancer patients and their families of approximately $25,440 per year. Another study shows that more than 10 percent of cancer patients have annual out-of-pocket costs that are higher than $18,585, and 5 percent have costs that exceed $35,660, in 2006 dollars, (Alliance for Aging Research, 2015) [27] or $22,235 and $42,663 in 2016 dollars.

According to estimates by Tangka, et al. [28] cancer leads to substantial numbers of lost work days each year - on average 6.1 days per case. Nearly half of those diagnosed with cancer (46.8 percent) were people of working age, under 65 years old. This sug-

gests national costs of absenteeism, in the tens of millions of dollars, perhaps much higher. The cost of lost productivity from premature deaths attributed to cancer was $123 billion and expected to rise to $147.6 billion by 2020.

Absenteeism is one important factor affecting productivity. While the cost of absences is more often being measured, rarely measured is the economic burden of "Presenteeism," or the lower productivity of a sick or injured worker who comes to work but, because of work-related infirmities, cannot perform tasks fully or efficiently. And, even more rarely calculated is the presenteeism of caregivers - workers who often are exhausted and may need to use work time for making arrangements for their injured or sick loved ones. Studies of absenteeism and presenteeism provide evidence that if one wants to increase productivity, part of the solution is "An integrated approach to mitigate job-related injuries, promote employee health, and improve the fit between a worker's duties and abilities" [29]. Hemp, writing in the Harvard Business Review, (2004) [30], argues that presenteeism can be significantly costlier than absenteeism and that *presenteeism* "Can cut individual productivity by one-third or more." He goes on to explain that unlike absenteeism, presenteeism is not always apparent and one may not be able tell how much a medical condition is hindering someone's performance.

Cancer and its treatments lead to the loss of economic resources and opportunities, not only for patients, but also for their families, employers, and society overall [25], as well as a reduction in the government tax base. There are monetary losses from time spent receiving medical care, out-of-pocket expenditures by patients and their families and their caregivers, time lost from work, and lost productivity from premature death.

In 2009 the national internet-based Harris Interactive Chronic Illness Panel selected a random sample of people with chronic diseases and found that, even among these respondents who were better off than those in the overall panel, most (41 percent to 66 percent) had had trouble affording their medications and had either cut back on medicines, omitted medicines, cut back on basic needs, or incurred credit card debt in order to pay for their medicines. Furthermore, patients reported that the economic recession at the time had made it more likely that they would forego medicines for financial reasons [31].

Sixty percent of the economic burden of cancer is in non-health care areas, much of it in lost productivity at the workplace [32]. Overall cancer costs estimated by the National Institutes of Health (NIH) were $226.8 billion in 2007 -- $103.8 billion for direct medical costs and $123 billion for indirect costs. But these numbers do not include absences among survivors, a cost of another $8.1 billion, or $8.5 billion in 2016 dollars, which need to be added to the NIH cost estimates [28]. OSHA in its $afety Pays Estimator (U.S. Department of Labor, OSHA, n.d.) [22] estimates both the direct and indirect costs of cancer, finding the direct costs at $129,624 and the indirect costs at $142,586, for a total per case of $272,210. The amount of sales needed to pay for each case is $907,000 to $1,361,000 if the profit margin in the rail industry is 20 percent to 30 percent, for a total of $685 million to $1.0 billion for the expected 755 excess cancer deaths among current active maintenance-of-way workers who currently have cancer.

Social Costs of Cancer

As cancer increasingly becomes a chronic disease rather than a short-term death sentence, patients are more interested not only in surviving, but also in the quality of that survival [33]. CDC and NCI data (U.S. Department of Health and Human Services, National Cancer Institute, n.d.) [34,35] indicate that over 64 percent of men, 1988-2013, survived cancer for at least ten years.

Cancer can have a negative impact on the quality of a patient's daily life in many ways. Surviving cancer is not the end of the disease's impacts. Cognitive impairment can last for years after treatment is finished [36]. There may be pain, fatigue, psychological distress, and problems with workforce participation [32]. Chronic pain can be long-lasting, resulting from both tissue damaged by the cancer and treatment-related toxic damage. Depression often accompanies cancer and affects both quality of life and the trajectory of the illness [37]. In fact, depression is a comorbid and disabling problem that affects 15 percent to 25 percent of cancer patients (U.S. Department of Health and Human Services, National Institutes of Health, n.d.) [20].

Cancer significantly affects all members of the family. Serious illness or death of a parent are two of the most severe things that can affect a child [38]. Impaired parental health is strongly associated with psychosocial problems in their teenagers [39]. Cancer patients and their partners have a higher risk of mental disorders, cardiovascular diseases, and suicide [40]. Approximately 14 percent of cancer patients live with their minor children, and children (under 18) of cancer patients have an increased risk for death from any cause [40]. As for adult children, Teixeira and Pereira found many traumatized by the caregiving experience and presenting both physical and psychological symptoms - some similar to PTSD [41].

Close to one-third of cancer survivors experience limitations in their ability to perform activities of daily living. Thirty-five percent of all men who were cancer survivors made changes in their work because of their cancer (Alliance for Aging Research, 2015) [27]. In one study [42], 42 percent of cancer-surviving participants reported a significant financial burden from their cancer and as a result:

- 19 percent only partially filled a prescription
- 20 percent took less than the prescribed amount of medication

- 24 percent avoided filling prescriptions
- 46 percent used their savings to help cover out-of-pocket expenses
- 46 percent reduced spending on food and clothing
- 68 percent cut back on leisure activities.

Costs of Cancer to the BMWED Membership and to Individuals. Working aged BMWED

Members are estimated to have died at 1.79 times the rate in the general male population. If there are approximately 15 million adults currently with some form of cancer in the U.S., that is 6.02 percent of the 249 million adult population. And 45.4 percent of new cases were individuals age 20-64 (U.S. Department of Health and Human Services, National Cancer Institute, n.d.) [20], or 2.73 percent of the population. Therefore, among working aged BMWED members, if MOW workers got cancer at the same rate as the general population, there would be an estimated 956 expected cancer cases among working BMWED members currently. But the standardized mortality ratio study done for this research, shows an SMR of 1.79 for BMWED members, meaning the expected number of those who will have cancer is instead 1,711, suggesting 755 excess cases among BMWED members. If the average total cost of cancer, according to OSHA is $272,210, then the excess cost of cancer - above the cost of cancer that would be expected -- is $226.1 million. And this does not account for a number of other social and economic burdens, some direct and some indirect. Using the NCI estimate of $376,220 per case, the cost to the estimated BMWED community from cancer alone would be much higher, at $304.6 million.

So, how much does cancer cost the average MOW rail worker stricken by cancer? Approximately $25,400 out-of-pocket over the course of their disease, with some paying substantially more. There are lost wages for the rail worker, and often for a family member. There are lower employer and employee retirement contributions made, resulting in lower retirement payments.

Data show that half of all men have cancer at some point in their lives, and lifetime out-of-pocket expenses alone are $25,400 on average; so, just among active working BMWED members, 17,500 are likely to have cancer during their lives, with combined out-of-pocket expenses over the course of their disease of $436 million. If the average cancer patient survives more than five years, then out-of-pocket expenditures would expand to well over $127,000 per person. For the 755 BMWED excess cases currently living, those out-of-pocket expenses are expected to be approximately $19.2 million - but to be conservative, we estimate the cost at half that, or $9.6 million.

Added to the above costs are lost income for family members who are caretaking; cash payments to caretakers; lost future Social Security and retirement income for family caretakers; out-of-pocket co-pays, drugs, travel to doctors and parking; lost future income to children who forego education in order to care for a sick relative or who forego income by postponing entrance into the work force.

The total estimated cost of cancer associated with each affected BMWED member is $300,000 to $404,000. The excess cancers due to work exposure, of current BMWED members with cancer, cost the BMWED community $226 million to $305 million. (See Table 2.)

Cost Category	Average Cost to the Individual	Cost to the BMWED Community (in million $s)
Direct and Indirect Costs (as estimated by OSHA and NCI)	$272,210-$376,220	$205.5-$284.0
Presenteeism (12 days a year, at $27.93 per hour, assumed to be working on the job for 5 years with the disease, assuming 1,665 excess members with cancer)	$13,405	$10.10
Unpaid Caretaker Wages (at $12.51/hour for 18 hours per week for 5 years [$11,709], for 10% of the 755 excess deaths)	$1,171	$0.90
Out-of-Pocket Expenditures (at $25,440 per caregiver and 10% of excess cases, or 75.5, for five years)	$12,720	$9.60
TOTAL	**$299,506-$403,516**	**$226.1-$304.6**

*These costs are spread across several groups: individuals and their families, employers, insurance companies, government entities, and society at large. Sources: Calculations within this report.

Table 2: Estimated Costs of Cancer to Individuals and to the BMWED Community.

Summary and Conclusions

Maintenance-of-way workers on the railroad face many hazards and dangerous exposures. As a result, many more get sick or are injured than in the general population. For every cancer in the general male population 18-64, there are 1.79 among MOW workers, and for some cancers - liver, pancreas, and stomach, for example -- it is more than double. Calculating direct and indirect costs, the average cost per MOW worker with cancer is $272,000 - $376,000. Total cost over their time with the disease, for those now with the disease (minus the expected number of cancers based on the general population), is $206 million to $304 million.

Not included in these costs are cash payments to caretakers; lost future Social Security and retirement income for family caretakers; out-of-pocket co-pays, drugs, travel to doctors and parking; lost future income to children who forego education in order to care for a sick relative or who forego income by postponing entrance into the work force, legal fees, specialized equipment, home modifications, and physical aids and a myriad of effects related to pain and suffering.

There is a broad range of potential policies and workplace changes that could simultaneously improve worker health and safety and also improve productivity and save money for workers, their families, their communities, railroad companies, and taxpayers. Healthy workers are more productive workers. So, any improvements are likely to be a win-win situation.

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