

Indirect Cost of Traumatic Brachial Plexus Injuries in the United States

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INTRODUCTION

- Traumatic brachial plexus injuries (BPI) pose a significant economic burden to the United States healthcare system, as they disproportionately affect young, able-bodied patients
- Beyond the direct costs associated with medical treatment, there are far-reaching indirect costs for BPI patients relating to workforce productivity that have not yet been estimated
- Objective:** Estimate the per-patient indirect cost associated with traumatic BPI

METHODS

- We estimated indirect costs as the sum of (1) short-term wage losses; (2) long-term wage losses; and (3) disability payments
 - Short-term (6 month) wage losses were the product of missed work days and average earnings per day accounting for fringe benefits

$$\text{Short Term Wage Losses} = (\text{Missed Days}) \times (8 \times \text{Hourly Wage}) \times (1 + \text{Fringe Percentage})$$

- Probability of return to work was derived from a systematic review
- Long-term wage losses and disability payments were estimated
 - Long term wage losses were estimated using a combination of permanent total and partial disabilities
 - Permanent total disability was estimated as being equal to lifetime earnings using the methods used in the Web-based Injury Statistics Query and Reporting System (WISQARS) Cost of Injury module

The equation to calculate lifetime earnings for a person of age a and sex b is as follows:

$$\text{Earn}_{a,b} = \sum_{k=a}^{100} \left\{ P_{a,b}(k) \times Y_{k,b} \times \left(\frac{1+g}{1+d} \right)^{k-a} \right\}$$

where $P_{a,b}(k)$ is the probability that a person of age a and sex b will live until age k , $Y_{k,b}$ is the average value of annual earnings with fringe benefits for a person of age k and sex b , g is the productivity growth rate which was set at 0.01 for earnings, and d is the discount rate set to 0.03

- Probabilities of survival ($P_{a,b}(k)$) were calculated from the 2014 CDC's National Vital Statistics Reports' United States Life Tables
- Earnings by age and sex were obtained from the Annual Social and Economic Supplement of the Current Population Survey obtained through the University of Minnesota's IPUMS archives
- The earnings data from 2010 to 2017 were combined and adjusted to 2018 dollars using the Employee Cost Index obtained through the US Department of Labor
- Monte Carlo simulation was used to perform a sensitivity analysis of long-term wage losses by varying age and gender simultaneously
- Disability benefits were estimated from the Social Security Administration. All cost estimates are in 2018 US dollars

Table 1: Bureau of Labor Statistics, Occupational Employment Statistics included in estimating short term wage losses, May 2017

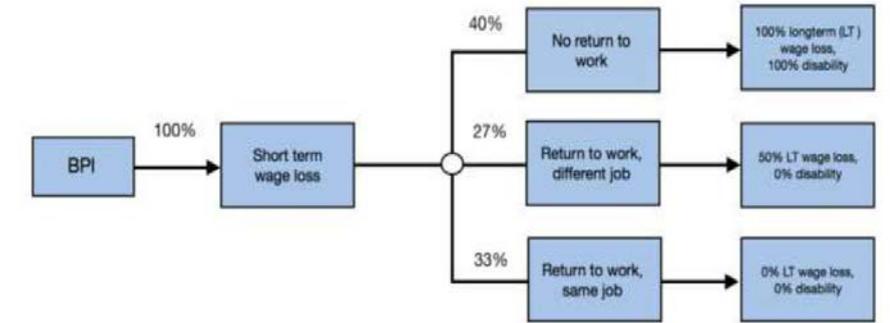
Occupation Code	Occupation Title	Mean Hourly Wage	Mean Annual Wage
35-0000	Food Preparation and Serving Related Occupations	\$11.88	\$24,710
37-0000	Building and Grounds Cleaning and Maintenance Occupations	\$13.91	\$28,930
45-0000	Farming, Fishing, and Forestry Occupations	\$13.87	\$28,840
47-0000	Construction and Extraction Occupations	\$24.01	\$49,930
49-0000	Installation, Maintenance, and Repair Occupations	\$23.02	\$47,870
51-0000	Production Occupations	\$18.30	\$38,070
53-0000	Transportation and Material Moving Occupations	\$17.82	\$37,070
Combined		\$17.22	\$35,817

Table 2: Sensitivity analysis of indirect cost with variation in return-to-work probability after brachial plexus injury

	% of BPI patients who do not return to work	% of BPI patients who return to work, different job	% of BPI patients who return to work, same job	Average short-term wage loss per patient	Average long-term wage loss per patient	Average lifetime disability payment per patient	Average lifetime indirect cost per patient
Case 1	40% (derived from systematic review)	27%	33%	\$22,740	\$813,652	\$384,606	\$1,220,998
Case 2	30%	37%	33%	\$22,740	\$735,521	\$284,784	\$1,043,045
Case 3	20%	47%	33%	\$22,740	\$658,145	\$187,102	\$867,987
Case 4	50%	27%	23%	\$22,740	\$970,136	\$485,283	\$1,478,159
Case 5	60%	27%	13%	\$22,740	\$1,119,146	\$579,624	\$1,721,510

• Base case: 26 year old male manual laborer who sustains BPI
 ○ BPI patients who return to work, different job – 50% former wage, 0% disability payments
 ○ BPI patients who return to work, same job – 100% former wage, 0% disability payments
 • Cases 1 to 5 vary the proportions of return to work possibilities.

Figure 1



Markov model for indirect cost calculation

RESULTS

- Systematic review demonstrated the following demographics for BPI patients:
 - Mean age 26.43 years, 90.5% male, most-represented occupation is manual labor
- Our base case: 26 year-old American man working as a manual laborer prior to BPI, with an annual wage of \$36,590
- Monte Carlo simulation estimates:
 - Short-term wage losses: \$22,740
 - Long-term wage losses: \$813,652
 - Disability benefits: \$384,606
- Total indirect cost of traumatic BPI: \$1,220,998 (per patient over the post-injury lifetime)
- If the probability of the patient returning to the workforce in a different, lower-paying job is doubled, per-patient total indirect cost is \$867,987.

CONCLUSION

- Traumatic BPI are devastating injuries that disproportionately impact young adults
- Beyond loss of physical function for the patient, there are societal implications including loss of productivity at work, absence from work, and disability.
- Indirect cost estimate per patient suggests that traumatic BPI has a far-reaching economic impact
- Continued need for allocation of resources with the goals of improving patient outcomes and restoring patient's ability to return to employment
- With continued efforts to improve clinical outcomes, the indirect cost of BPI from both the patient and society could be dramatically decreased

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