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SAFE PATIENT HANDLING – A CASE FOR NATIONAL LEGISLATION

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SAFE PATIENT HANDLING – A CASE FOR NATIONAL LEGISLATION

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David O. Oba, MPH, DrPH
2020

DEDICATION

To my grandmother, Deaconess Janet I. Adetuberu (deceased). Though without a formal education, you would not settle for anything short of the best education for me. To my dad, Mr. Ezekiel B. Oba (deceased). You never said much, but your actions spoke- and still speak volume. I wish you two were here.

SAFE PATIENT HANDLING – A CASE FOR NATIONAL LEGISLATION

by

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SAFE PATIENT HANDLING – A CASE FOR NATIONAL LEGISLATION

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Abstract

Introduction: This study examined the effectiveness of Safe Patient Handling (SPH) legislations in difference states across the country. In January 2006, the state of Texas legislated the Safe Patient Handling and Movement Practices Act which required all hospitals and nursing homes to implement safe patient handling and movement program. To date, 10 other states have enacted law or regulations to control work-related musculoskeletal disorders (MSDs) among healthcare workers (HW). Despite the effectiveness of these policies in the individual states, MSDs remain prevalent among HW nationwide. Hence, the call for national legislation. *Methods:* Using the state-level incidence rate data from the Bureau of Labor and Statistics (BLS), piecewise regression and difference-in-difference (DiD) estimates were used to compare the incidence rates before the implementation of the safe patient handling policy with those after policy implementation. This comparison was followed by a systematic analysis of the legislative mandates in states with SPH laws. An eight-step framework (as adapted from Bardach's Eightfold Path to More Effective Problem Solving,) was employed in this policy analysis.

Results: The piecewise regression analysis indicated positive effects of SPH in the form of increase in downward trends of total MSDs in New York, New Jersey, and Missouri following implementation. The results of DiD estimates indicate significant correlation between the implementation of SPH legislation and reduction in the incidence rates of MSDs in Texas, Maryland, Minnesota, and Missouri.

Conclusion: Variation in the results of both analyses could be attributed to variations in the policies – in terms of elements, implementation, and enforcement. Setting a nation-wide minimum standard for safe patient handling will help minimize the incidence rates of MSDs among HW. Therefore, a prototype was developed for national legislation, considering the strengths and limitations of reviewed state policies

TABLE OF CONTENTS

<i>Acknowledgements.....</i>	<i>v</i>
<i>List of Tables.....</i>	<i>ii</i>
<i>List of Figures.....</i>	<i>iii</i>
<i>List of Appendices</i>	<i>iv</i>
<i>Background</i>	<i>1</i>
Public Health Significance.....	5
Specific Aims.....	7
<i>Methods</i>	<i>8</i>
Methods for Model 1- Piecewise Regression.....	10
Methods for Model 2: Difference-in-Differences Estimation	11
Methods for Specific Aim 2 – Policy Analysis.....	15
Ethical Considerations.....	17
<i>RESULTS of Specific Aim 1, Models 1 and 2</i>	<i>18</i>
Model 1- Piecewise Regression.....	22
Model 2- Difference-in-Difference	24
<i>Discussion of Specific Aim 1 Models.....</i>	<i>29</i>
<i>Specific aim 2 - Safe Patient Handling Policy Analysis and Discussion.....</i>	<i>30</i>
<i>Conclusion</i>	<i>45</i>
Study Limitations	46
<i>Appendices</i>	<i>48</i>
<i>References</i>	<i>55</i>

LIST OF TABLES

Table 1: Summary of all states' MSD incidence rates from 2003-2018.....	19
Table 2: Summary of the incidence rates of all MSDs by state from 2003 - 2018.....	20
Table 3: Piecewise regression results, slope of log-transformed incidence rates	23
Table 4Table 4: DiD estimation for MSDs in all SPH states from 2003 to 2018.....	27
Table 5: Summary of all existing SPH laws in the United States.....	39

LIST OF FIGURES

Figure 1: Bardach’s Eightfold Path to More Effective Problem Solving	17
Figure 2: Annual average of the incidence rates of MSDs from 2003-2018	21
Figure 3: Histogram of raw total incidence rates for the study population	22
Figure 4: Histogram of log-tranformed total incidence rates for the study population	22
Figure 5: Sample line plot with similar MSD trends	25
Figure 6: Sample line plot with disparate MSD trends	26

LIST OF APPENDICES

Appendix A: Proposed National Safe Patient Handling Act	48
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BACKGROUND

Patient handling and mobilization activities in acute care hospitals are a fundamental aspect of patient care; this area has, over the years, also been recognized as a major musculoskeletal disorder (MSD) hazard. This transition is, at a fundamental level, partly due to civilization, advanced science, and improved standards of living and health care. These have directly and indirectly contributed to a shift from acute infections to more chronic cases, increasing obesity, and dealing with an ageing population. An average critical care nurse currently lifts three tons daily, making patient lifting the primary reason that 52% of nurses report back pain and 18% leave the profession annually because of injury (Aslam, Davis, Feldman, & Martin, 2015) . There are significant risk factors for MSD in the healthcare system (Aslam et al., 2015; Pruitt et al., 2002). An estimated 80 million Americans will be 65 years and older by 2040, and 29 million of those individuals will have some degree of disability (Martiniano, Chorost, & Moore, 2016). As a result of all these factors in the United States, a significant percentage of hospital patients are older citizens with limited-to-no mobility, requiring lifting and presenting the associated risks.

The Centers for Disease Control and Prevention (CDC, 2018) defined MSDs as soft-tissue injuries that result from either acute or chronic exposure to repetitive motion, force, vibration, or awkward positions. For the purpose of this work, MSDs are defined as work-related non-fatal injuries and- or disorders affecting the skeletal and muscular systems of the body. Such diseases and disorders include but are not limited to sprain, strain, bruises, fractures, dislocations, and arthritis in any part of the body.

Epidemiological studies have attributed about one-third of all musculoskeletal injuries in the healthcare sector to patient handling, with the highest rates among Nurses' Aides, housekeepers, dietary services, radiology technicians, and inpatient nurses (Pompeii, Lipscomb, & Dement, 2008). In 2011, the incidence of musculoskeletal disorders in healthcare was seven times the national rate for all industries (Ann Adamczyk, 2018). The risk of such disorders is secondary to the physical demands of patient care, such as patient lifting and mobilization. Patient handling also contributed significantly to reduction in the level of job satisfaction and high turnover among nurses (Aslam et al., 2015). Given the progressive increase in patients' weight across the country, there is an increased risk of musculoskeletal injuries among healthcare workers (HW-MSDs). Between 2006 and 2015, there was a seven-pound increase in mean weight in inpatient acute care setting (VanGilder, Lachenbruch, Algrim-Boyle, & Meyer, 2017). These patient handling hazards not only affect the health and standards of living of the care providers; the comfort and recovery of the patients and the facility's reputation and finances are on the line.

A work-related MSD (such as pain in the back, shoulder, or any of the extremities) sustained by a healthcare provider will directly affect his/ her ability to effectively and safely provide patient care. Such injury will not only put the provider at risk, but also put the patient at risk of injuries and-/ or delayed recovery. Compromised patient safety could in turn mean financial and business liabilities for the healthcare facility. Workers' compensation claims are another potential source of liability. Workers' compensation claims cost the state of Oregon over \$54 million in 2010 with an average of \$16,930 per claim (*Oregon OSHA*

reports and statistics.2012). The cost of workers' compensation claims to Washington State was estimated at approximately \$33 million annually (Lee, Lee, & Gershon, 2015). A recent report by the Texas Department of Insurance indicated (2017) a total of 6,711 workers' compensation claims from the healthcare sector in 2016 with an average of \$11,633 per case. Other risks include possible legal actions and regulatory fines against the facility. In an effort to mitigate these hazards, the state of Texas and some other states instituted various versions of Safe Patient Handling (SPH) and mobilization legislations.

The outdated tasks of manually lifting patients have been described in various studies as inefficient and unsafe for both patients and caregivers. In January 2006, the state of Texas became the first state to successfully legislate a Safe Patient Handling and Movement Practices Act that required all hospitals and nursing homes to implement safe patient handling and movement program. Published in chapter 256 subtitle B, Title 4 of the Texas Health and Safety Code, this policy established a process that included the analysis of patient handling injury risks to both HW and patients, and provided alternative ways to remediate such risks (Texas Health and Safety Code, 2006). It was aimed at minimizing the risks of HW-MSDs, enhancing patients' recovery, and minimize the associated costs. To date, 11 states (OH, TX, WA, RI, MD, NJ, MN, IL, NY, MO, and CA) have enacted laws or regulations to control work-related HW-MSDs (Lee et al., 2015; Weinmeyer, 2016). Each of these states' legislation has different mandates, requirements, and levels of enforcement. Ohio HB 67, Section 4121.48 was passed in 2006 but repealed in 2015.

The safe patient handling (SPH) legislation in each of the aforementioned states (except OH) requires, at a minimum, the establishment of a policy or committee to control MSD risks in healthcare facilities. The Minnesota SPH program established loans and grants, which could be used to finance SPH in long-term and acute care facilities. The definitions and elements of such policies vary by state. California has a “zero lift” policy and defines lift teams as employees trained to use patient lift equipment. The safe patient handling policy, as defined under the California Labor Code (2011), requires the replacement of manual lifting with equipment use. Maryland’s Senate Bill 879 defined Safe Patient Lifting as the replacement of manual patient lifting, transfer and repositioning by hospital employees with the use of mechanical lifting devices. Ohio and Minnesota legislations provided grants and interest-free loans for healthcare employers to use for implementing or improving their SPH.

Brigham (2015) reviewed the contents of the acts in 12 states. What these policies have in common is that 10 out of the 12 states (excluding OH and HI) require the establishment of safe patient handling committees and programs. While this requirement is common to these states, the elements of the programs, periods of implementation, and extent of enforcement vary. Ohio provides financial incentives such as interest-free loans to support safe patient lifting initiatives, while HI issued a statement in support of American Nurses Association’s (ANA) “Handle with Care” campaign.

An evaluation of a safe patient handling program revealed an 18% decrease in lost workdays following program implementation (Nelson, Audrey et al., 2006). This study also linked patient lifting equipment to an annual savings of over \$200,000 in workers comp expenses and cost savings related to reduced lost/ modified workdays and workers

compensation, with a 100% Return on Investment (ROI) in approximately 3.75 years (Nelson et al., 2006). A cost-benefit analysis of peer coaching for overhead lift in some Canadian long-term care facilities indicated benefit-to-cost ratios ranging from 0.05 to 2.31 (Tompas, Dolinschi, Alamgir, Sarnocinska-Hart, & Guzman, 2016). According to this study, the coaching for overhead lift was effective with 34% and 56% reductions in injury rates during and after program implementation respectively. Another study linked the ceiling lift to a significant and sustained reduction in in days lost, workers' compensation claims, and direct costs associated with patient handling injuries (Chhokar et al., 2005).

Despite the enactment of some form of Safe Patient Handling law in about 20% of U.S. states, the healthcare industry has experienced a significant turnover of nurses, nursing assistants, and other HW due to musculoskeletal disorders resulting from repeated manual patient lifting. MSDs remain prevalent among HW nationwide (Pompeii et al., 2008); workers' compensation claims, disability claims, and general (direct and indirect) costs of manual patient lifting remain high (Lee et al., 2015). Given the effectiveness of these policies in the individual healthcare facilities, an enactment of a National Safe Patient Handling policy will help reduce the incidence of HW-MSDs.

Public Health Significance

Patient lifting and mobilization are significant operations in the healthcare industry, exposing both providers and patients to musculoskeletal hazards. A critical care nurse lifts, on an average, three tons per day, making patient lifting responsible for reported back pain in 52% of nurses with 18% leaving the profession annually due to injury (Aslam et al., 2015).

The costs of unregulated or poorly regulated patient handling are paid by all stakeholders, from the patients and HW to healthcare facilities and insurance providers. In order to mitigate these costs, various forms of SPH legislation were enacted in 11 states, starting with TX in 2006.

This study is expected to help justify the establishment of a nation-wide Safe Patient Handling policy, with the ultimate goal of reducing the incidence rate of MSDs related to patient lifting among U.S. healthcare providers. Highlighting the strengths and limitations of individual state's SPH policy will influence the review of such policies as needed. Finally, it will add to the knowledge base various fields of study e.g. Healthcare Policy, Administration, Ergonomics, Health Economics, and Occupational Safety.

Some studies have investigated the effectiveness of the various lift systems (Aslam et al., 2015; Nelson, A., Cormier, Siddharthan, Matz, & Waters, 2008) . The effectiveness of states' Safe Patient Handling policies have been examined (Ann Adamczyk, 2018; Kurowski, Gore, Roberts, Kincaid, & Punnett, 2017; Lee et al., 2015). Previous studies have shown (at the state level) that a properly implemented SPH policy is effective in reducing the incidence of HW-MSDs. This study will not only assess the need for national SPH legislation, but also provide suggestions based on the strengths and limitations of current state-level SPH legislations. Finally, data from this study will provide baseline information for evaluation and review of the Safe Patient Handling policy and its elements.

Specific Aims

The broad goal, over time, of this research is to reduce the incidence and severity of HW-MSDs. This goal is addressed by analyzing the safe patient handling policies based on the incidence rate of HW-MSDs and suggesting a national policy, based on the analysis of the status quo.

Given the prevalence of HW-MSDs and its effect on the quality of care given to patients, the National Occupational Research Agenda (NORA) has set a goal to reduce the incidence and severity of MSDs among healthcare workers.

This study has the following specific aims:

1. Evaluate the incidence of musculoskeletal injuries among direct patient caregivers in acute and long-term care settings. A comparative analysis of the pre- and post-intervention data is presented to compare the incident rates before the implementation of the safe patient handling policy with those after policy implementation. This evaluation forms the basis for a combined analysis of SPH policies. It is hypothesized that the incidence rates of MSDs among U.S. healthcare workers after the enactment of SPH legislations are lower than those before the enactment.
2. Analyze the SPH policies in the states with such legislation. Safe Patient Handling policies are reviewed by conducting a systematic analysis of the legislative mandates in states with SPH laws. Policy analysis is presented based on the consequences of the status quo with the descriptive and

prescriptive information about the strengths and weaknesses of the current policies.

METHODS

Specific Aim 1: Evaluate the incidence of musculoskeletal injuries among the nursing staff (Nurses and Nurse Aides) in acute and long-term care settings.

Data and Model Specification

This study involves a pooled cross-sectional study of the incidence of HW-MSDs. Epidemiological data for this work were retrieved from the Bureau of Labor and Statistics (BLS) database. The BLS collects, analyzes and disseminates essential economic information to support public and private decision-making (U S Bureau of Labor Statistics, 2019) . The Occupational Injuries and Illnesses and Fatal Injuries Profiles are interactive records of incidence rates of injuries across the country and from different industries from 1992 to 2018. No data were available for the health care industry prior to 2003. In 2003, BLS announced a change in the basis of industry classification from the Standard Industrial Classification (SIC) System to the North American Industry Classification System (NAICS) (U S Bureau of Labor Statistics, 2014). The study included annual cases and demographic incidence rates from all states in the U.S. However, due to data availability and changes in BLS classification, and to ensure data consistency throughout the period of study, inclusion criteria included:

- Time Period: Year 2003 to 2018.

- Industry: Healthcare and social assistance /(NAICS 62)
- Nature of injury and illness
 - Sprains, strains, and tears;
 - Carpal Tunnel Syndrome (CTS);
 - tendonitis;
 - Multiple injuries with sprains; and
 - soreness, pain.

Note: Total incidence rates are calculated as the total of all five injury classes above.

- Ownership category of source industry: Private (government facility data were not available)

The time period before the implementation of the SPH programs in each state, and the post-implementation years to date represent the pre- and post-intervention periods respectively.

A set of de-identified state level data was retrieved from BLS Occupational Illness and Injuries and Fatal Injuries Profiles (U S Bureau of Labor Statistics, 2019). This database is an interactive research tool that allows the selection of various criteria such as table type (case, incidence rates, or annual summary), time period, states, and industries in any combination desired. These data included records of occupational musculoskeletal injuries in the U.S. healthcare industry. The date range for these data was from 2003 to date, representing both pre- and post-intervention periods.

Study Variables:

- SprStr: Sprain and Strain
- CTS: Carpal Tunnel Syndrome
- Tendonitis
- MIWSpr: Multiple Injuries with Sprain
- Soreness/Pain: Soreness and Pain
- Total IR: Total Incidence Rate = SprStr + CTS + Tendonitis + MIWSpr + Soreness/Pain

Incidence Rate = (number of injuries and illnesses / total hours worked by all employees during the calendar year) X 20,000,000. Where 20,000,000 is the base for 10,000 full-time equivalent workers (working 40 hours per week, 50 weeks per year) (U S Bureau of Labor Statistics, 2019).

Methods for Model 1- Piecewise Regression

A piecewise regression was used to differentiate between the trends of MSDs among the SPH states pre- and post-implementation of their programs. This model compared the baseline incidence rates with those after SPH implementation.

$$Y_t = \gamma_0 + \gamma_1 t + \gamma_2 t * (\text{if } t > \text{intervention time}) + \varepsilon_t$$

where γ_0 is the constant indicating the baseline value of Y at the beginning of observation; γ_1 denotes the pre-intervention structural trend; γ_2 indicates the immediate effects of SPH programs right after implementation; (Lagarde, 2012).

A dummy variable “if $t > \text{intervention time}$ ” was generated with the value 0 before the implementation year and 1 otherwise. The data were log-transformed to minimize skewness. The Prais-Winsten estimator was used to correct for data autocorrelation (Lagarde, 2012). Testing of γ_2 is used to determine the effectiveness of SPH programs at state level. After running separate analyses for different MSDs in different SPH states, $\gamma_1 > \gamma_2$ indicates a positive outcome. Such outcome could either manifest in the form of increase in downward trend or a decrease in upward trend.

Since this model only compares an SPH state to itself, a Difference-in-difference model (Model 2) was introduced to determine if there was any difference in MSD trends between a SPH state and non-SPH states after the implementation of the program.

Methods for Model 2: Difference-in-Differences Estimation

A difference-in-differences (DiD) estimation was used to differentiate between the pre-intervention incidence rates and post-intervention incidence rates. The basic idea behind the DiD is a form of double-differencing between two sets of observations. Data series which are typically changing over time may be compared to detect a different rate of change in an intervention group, compared to a control group, after an intervention. Data are collected for a treatment population and the control before and after intervention. The difference in the values of the dependent variable between the treatment and control groups are noted, and that between the pre- and post-intervention groups. The DiD is the difference between these differences.

DiD estimation has been used in economic studies and is considered a benchmark tool in program evaluation (Delgado & Florax, Raymond J G M, 2015). Such topics have been investigated as the effects of cost sharing rates on outpatient services utilization among school-age children (Miyawaki, Noguchi, & Kobayashi, 2017), the impacts of universal free General Practitioner care on emergency department utilization (Walsh, Nolan, Brick, & Keegan, 2019); and the effects of London congestion charges on road casualties (Li, Graham, & Majumdar, 2012). Several other studies have employed the DiD to examine the effects of policies, regulations, and interventions.

To evaluate the impact of SPH legislations, the following DiD model (Daw & Hatfield, 2018; Krabbe-Alkemade, Groot, & Lindeboom, 2017; Li et al., 2012; Miyawaki et al., 2017) was used:

$$Y = \alpha + \beta T + \gamma t + \delta (T \cdot t) + \varepsilon$$

Y = Incidence rate for individual state at a particular time, representing the annual number of injuries and illness per 10,000 full-time workers

α = Intercept

T = Post-intervention period (Period after the enactment of individual state's SPH). This is a dummy variable with value "0" for pre-intervention and "1" for post-intervention entries

t = Treatment group (states with SPH). Dummy variable with value "0" for control group and "1" for treatment group

α = Intercept

β = Time trend

γ = Specific group effect

δ = Treatment effect of interest

ε = Error term

Twenty-five states were included in the empirical model (one treatment and 24 controls) with data from 2003 to 2018 (16 years). Therefore, total number of observations is $25 \times 16 = 400$. Assuming a 95% confidence level and using a two-sample inference (Cohen, 1988; Rosner, 1995), the statistical power is estimated to be greater than 95% to detect a significant difference if present

Assignment of Treatment and Control Groups

Given the differences in the scope and stringency of SPH from state to state, and socio-economic differences between the states, the DiD model was used to study the effects of SPH on one state with respect to another state. Due to the wide range of intervention years among the SPH states, the treatment group (SPH states) could not be combined in one analysis. Therefore, separate analyses were conducted for each of the SPH states; with all non-SPH states as the control group. Using the inclusion criteria highlighted above, 9 rounds of DiD analysis were run to include every one of the available 9 treatment states individually matched with all available control states.

The dependent variables for this model are the incidence rates of sprains and strain, carpal tunnel syndrome, tendonitis, multiple injuries with sprain, and soreness and pain. MSDs are classified as a nature of injury from 2011 to 2018 but absent from 2003 to 2010. Therefore, MSD was excluded from the data to maintain consistency. The Independent

variable was the SPH status. Dummy variables were created from the time and treatment variables. All states have the value-0 for entries prior to SPH implementation (pre-treatment) and 1 otherwise (post-treatment); all entries for states without SPH will carry the value-0 (control) and 1 for states with SPH (treatment).

The incidence rates of every injury were noted for the states with SPH (treatment group) as well as those without SPH (control group) pre- and post-treatment. The difference between the pre-treatment and post-treatment average incidence rates among the treatment group was calculated. The same was determined for the control group. The difference between these differences was an indication of SPH effectiveness.

The incidence rate of MSDs in the health care industry is hypothetically expected to decline following the implementation of SPH; this was indicated by a positive value of W . $C-D$, the change in the control states, may go either up or down. A positive value of Y shows that the change in the implementation states was larger than in the control states and is therefore associated with the implementation of SPH. The size of the difference was tested for significance.

Three assumptions are needed for the DiD to be consistent and unbiased.

- The construction and elements of the model are correct;
- The average value of the error term is zero; and
- The Parallel Trend Assumption (PTA) holds true for the analysis.

The PTA indicates that without treatment, both treatment and control groups will show a similar trend in the dependent variable. For this study, the PTA is that without the SPH

legislation, the trend of HW-MSDs will be similar nationwide, intervention state or not. A dummy variable (t) was created with value-1 for the treatment group (states with SPH) and value-0 otherwise. Another dummy variable (T) was created with value-0 for the incidence rates before 2010 and value-1 otherwise.

It is of importance to test the PTA for every analysis. This assumption is tested by comparing a line plot of the incidence rates for treatment state, up to intervention year with those of control states.

Methods for Specific Aim 2 – Policy Analysis

Policy analysis was conducted based on the consequences of the status quo as indicated by the DiD analysis of the effects of SPH legislation. Other consequences considered were days away from work, workers' compensation claims, turnover rates, and job satisfaction rates. By reviewing published literature, the effects on other stakeholders such as patients, employers, and the government will also be reviewed. Patients' recovery rates, costs of medical care, and costs of legal charges are examined as they relate to SPH legislations. The SPH policies from the treatment group (states with SPH) will be used as a template to develop a prototype, considering their strengths and limitations. Bardach's eight-step framework for effective problem solving was employed in this policy analysis (Bardach, 2016). These steps involve:

- Stating the problem: To date, 11 states have passed various forms of Safe Patient Handling legislation, all having different elements and varying levels of stringency and enforceability. Studies have shown how effective SPH policies (in healthcare facilities and states) have been in reducing MSD rates and connected costs among

HW. However, on a national scale, MSDs remain prevalent among HW, resulting in high turnover and low job satisfaction (and other effects).

- Searching for- and presenting evidence: Recent Bureau of Labor Statistics (BLS) data and literature review on MSDs in healthcare industry are presented. Also, results of the analyses from Aim 1 were presented as a parallel set of evidence of the current state of patient handling in states without SPH laws. It also highlighted the conditions before SPH implementation among the states that have it.
- Considering policy options: The policy option for consideration is a national model legislation for SPH. Considering the strengths and limitations of the SPH policies from the treatment group, a prototype of national SPH legislation was proposed. With well-defined scope and elements, this policy will not only protect healthcare workers against MSDs in the control states but also improve the existing SPH policies in the treatment states.
- Defining the standards for evaluating the intervention: Effectiveness of the SPH policy, as indicated by the analysis results from Aim 1 above and published literature, was part of the evaluative criteria for the proposed policy. The results of analysis from this study will serve as a reference against which subsequent studies would be compared to evaluate the continuous effectiveness of the policy.
- Projecting the outcome of the policy options: Considering the evidence of the effectiveness of SPH policies, as published in the literature, the projected outcome of this policy is a significant reduction in the incidence rates of HW-MSDs. There may

be skepticism and resistance by healthcare facilities from fiscal perspectives, considering the costs of implementing the SPH policy. Potential solutions for such issues were suggested.

- **Confronting Trade-Offs:** Anticipated impacts of these options and tradeoffs were considered from workers', patients', facility's, and governments' perspectives.
- **Decision making:** Policy decisions were suggested based on the presented evidences and analyses.
- **Presenting results:** Analysis is presented in this dissertation, with an end product of a draft of this proposed national policy.

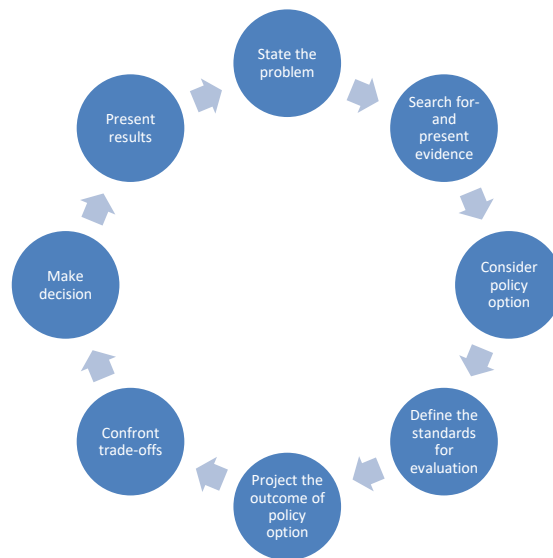


Figure 1: Graphic representation of Bardach's Eightfold Path to More Effective Problem Solving

Ethical Considerations

This study involved analyzing secondary data, which is publicly available online, and did not include Personally Identifiable Information (PII) nor any organization's financial

information. Because this study did not involve identifiable PII or direct use of human subjects, it was considered minimum risk; and therefore went through expedited review by the University of Texas Health Science Center Institutional Review Board (IRB). The study was determined to qualify for exempt status according to 45 CFR 46.101 (b). Upon exemption by the board, relevant data were downloaded from BLS website and stored on password protected computer.

RESULTS OF SPECIFIC AIM 1, MODELS 1 AND 2

Descriptive Data

Table 1 summarizes the incidence rates of HW-MSDs all 33 states in the study, with an average of 97.7 total cases per 10,000 full time workers over a 16-year period. Sprain/Strain and Soreness/Pain are the most reported MSDs with highest average rates of 69.5 and 21.9 respectively over the study period. Tendonitis, on the other hand, is the least reported. Only 16% of the annual data is available for this study with an average incidence rate of 1.2.

<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
<i>Year</i>	528			2003	2018
<i>SprStr</i>	527	69.48	32.64	21.2	218.6
<i>CTS</i>	155	1.99	2.55	0.1	18.4
<i>Tendonitis</i>	84	1.18	0.93	0.2	5.2

<i>MIWSpr</i>	364	3.15	2.22	0.4	16.7
<i>Soreness/Pain</i>	519	21.90	12.81	1.4	88.3
<i>Total IR</i>	527	94.00	37.85	24.9	268.7

Table 1: Summary of 33 states' HW-MSD annual incidence rates from 2003-2018

Table 2 summarizes the 16-year incidence rates of HW-MSDs by specific state. It should be noted that the top 10 states with the highest reported annual MSD incidence rates ranges from 118 to 156 per 10,000. About 80% of these states do not have any form of SPH legislation. The incidence rates range from 24.9 (Nevada in 2006) to 268.7 (Montana in 2003).

The distribution and trend of MSDs are identified by observing the incidence rate data for 33 individual states with suitable data during the period covered by the study. Figure 2 shows a general downward trend in the incidence of MSDs across the U.S. healthcare industry within the study period. In order to not only sustain but increase this downward trend, it is important to estimate the effects of each intervention.

<i>State</i>	<i>Mean</i>	<i>Std Dev</i>	<i>min</i>	<i>Max</i>
WV	156.16	51.67	92.8	266.1
MT	141.97	47.44	88.1	268.7
CT	141.26	20.93	103.8	189.7
WA*	135.31	24.22	103.5	194.4
NY*	134.50	12.02	114.7	154.8

<i>OR</i>	128.93	20.31	108.9	189.6
<i>VT</i>	126.01	31.60	85.6	202.5
<i>DE</i>	125.73	40.06	68	216.5
<i>HI</i>	119.74	24.68	88.4	185.5
<i>KY</i>	117.98	38.82	64.5	199.5
<i>ME</i>	115.59	20.88	87.4	156.8
<i>MD*</i>	107.23	21.21	81.7	150
<i>MN*</i>	103.33	24.29	73.5	164.8
<i>NJ*</i>	96.80	9.96	74.2	107.6
<i>NE</i>	88.94	22.99	63.7	135.8
<i>CA*</i>	85.41	14.74	68.2	131.2
<i>WI</i>	84.86	23.59	53.7	139.3
<i>IA</i>	83.19	27.43	49.5	141.9
<i>VA</i>	82.69	11.28	69.2	103.4
<i>MI</i>	81.35	14.48	62.5	117
<i>AL</i>	79.29	24.04	53.1	152.9
<i>IL*</i>	76.79	12.17	58	108.8
<i>AZ</i>	75.35	18.20	38	111.9
<i>AR</i>	72.24	22.91	42.1	121
<i>SC</i>	70.70	16.58	43.8	102.5
<i>IN</i>	67.63	10.46	51.9	90.3
<i>TN</i>	66.43	17.95	46	97.9
<i>GA</i>	63.39	11.04	43.3	91
<i>KS</i>	58.23	10.82	42.9	76.3
<i>TX*</i>	57.64	17.78	31.7	90.5
<i>NC</i>	56.68	12.58	40.1	84.7
<i>MO*</i>	51.13	18.87	25.3	78.1
<i>NV</i>	46.77	9.30	24.9	62.2
<i>Total</i>	94.00		24.9	268.7

Table 2: Summary of the incidence rates of Total MSDs 1n 33 states from 2003 – 2018

* = states with SPH legislation or codes

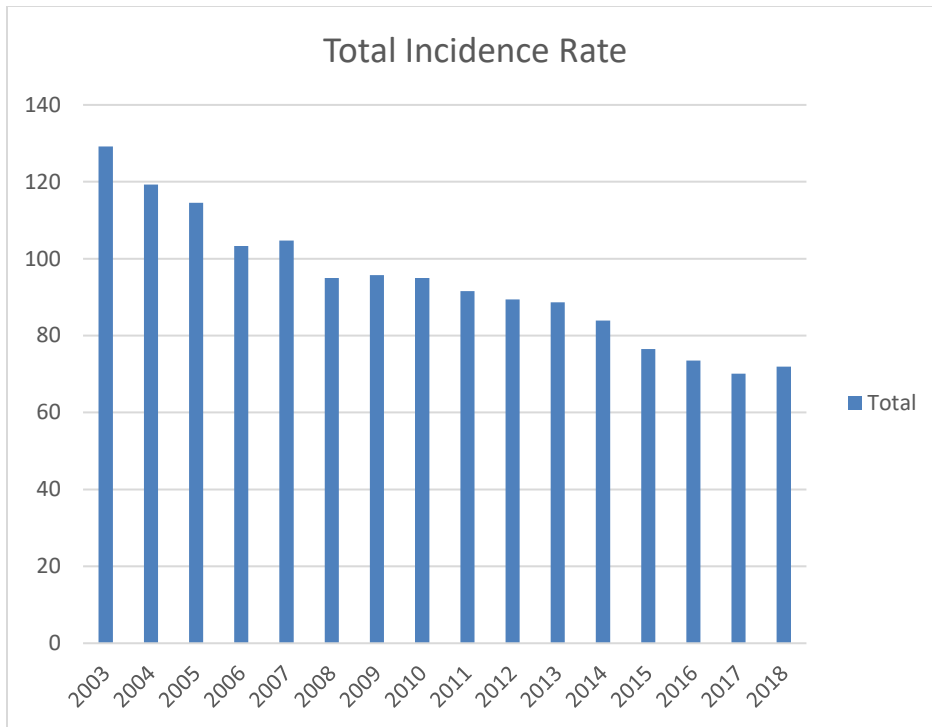


Figure 2: Annual average of the incidence rates of HW-MSDs from 2003-2018 (cases per 10000 FTE).

Overall, 33 states were included in this study with annual incidence rates reported from 2003 to 2018. Nine of these states have SPH legislation while the rest do not. Ohio is among the SPH states but was dropped from this analysis because of incomplete data. The same exclusion was applied to other states missing annual incidence rates.

After testing the data for normality collectively and separately for individual analysis, the incidence rates were log-transformed in Stata. Figures 3 and 4 represent the original and log-transformed total incidence rates of MSDs from 2003 to 2018 for individual state and general study population respectively. Separate analyses were conducted for the effects of

Sprain and Strain, CTS, tendonitis, multiple injuries with sprain, soreness and pain, and total MSDs (total incidence rates of all five aforementioned MSDs) in nine SPH states.

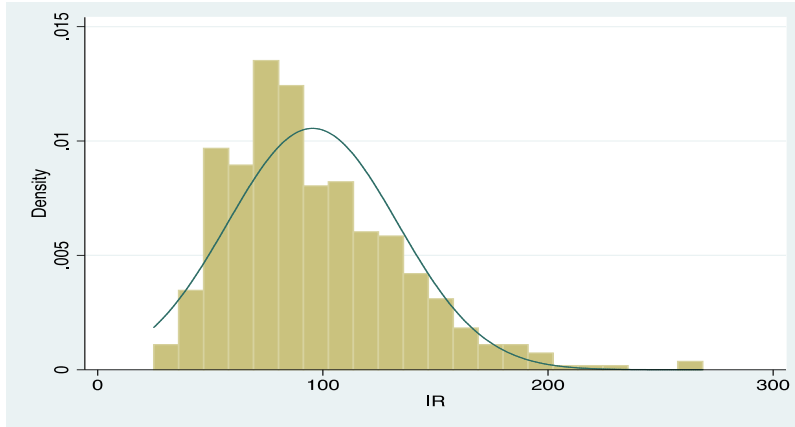


Figure 3: Histogram of raw total incidence rates for study population

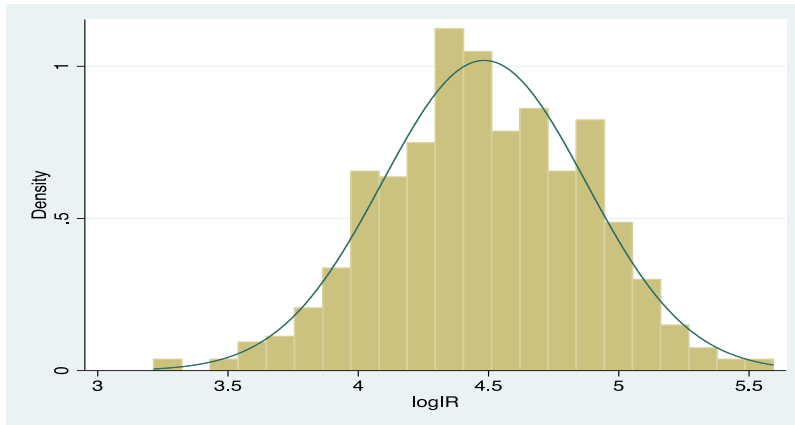


Figure 4: Histogram of log-transformed total incidence rates for the study population

Model 1- Piecewise Regression

As defined earlier in this study, a positive impact of SPH occurs when there is an increase in downward trend or a reduction in upward trend of an MSD rate. Results of the piecewise regression are presented in table 3. These results compare the slopes of the pre-

intervention incidence rates of MSD (from the beginning of the study to intervention year) with those post-intervention (from intervention year to the end of the study). The effectiveness of SPH legislation in reducing the incidence rates of HW-MSDs is measured by the difference between slopes before- (t) and after implementation (t^*), i.e. $\gamma_1 - \gamma_2$. A positive value (in Bold) indicates a program with change consistent with effectiveness

	<i>State: Pre/Post</i>	<i>SprStr</i> (ln)	<i>CTS</i> (ln)	<i>Tendoniti</i> <i>s</i> (ln)	<i>MIWSpr</i> (ln)	<i>SorePain</i> (ln)	<i>TotalIR</i> (ln)
TX	γ_1	-0.0834	----	----	-0.374	-0.120	-0.107
	γ_2	-0.070***	----	----	-0.001	-0.013*	-0.059*
	$\gamma_1 - \gamma_2$	-0.013			-0.373	-0.107	-0.048
CA	γ_1	-0.049**	-0.087	0.036	0.058	0.012	-0.039
	γ_2	-0.012*	-0.147	-0.032	-0.141**	0.001	-0.004
	$\gamma_1 - \gamma_2$	-0.037	0.06	0.068	0.199	0.011	-0.035
IL	γ_1	-0.053***	-0.119	-0.456**	-0.070	0.007	-0.042***
	γ_2	-0.074***	-0.042	----	0.003	0.091*	-0.033**
	$\gamma_1 - \gamma_2$	0.021	-0.077		-0.073	-0.084	-0.009
WA	γ_1	-0.086**	-0.451**	-0.188*	-0.044	-0.255	-0.103***
	γ_2	-0.048***	-0.135***	0.058*	-0.227***	0.140***	-0.023***
	$\gamma_1 - \gamma_2$	-0.038	-0.316	-0.246	0.183	-0.359	-0.08
MD	γ_1	-0.098***	----	----	-0.309*	0.545***	-0.043
	γ_2	-0.055***	----	----	-0.043	0.059**	-0.026***
	$\gamma_1 - \gamma_2$	-0.043			-0.266	0.486	-0.017
NY	γ_1	-0.021***	-0.165**	-0.060	0.086	-0.004	-0.014***
	γ_2	-0.075***	0.469**	-0.370	0.127	0.017	-0.038**
	$\gamma_1 - \gamma_2$	0.054	-0.634	0.31	-0.041	-0.074	0.014
NJ	γ_1	-0.019	----	-0.271***	0.074	-0.056	-0.011
	γ_2	-0.056***	----	0.062	-0.055*	0.067*	-0.023
	$\gamma_1 - \gamma_2$	0.037		-0.333	0.129	-0.123	0.012
MN	γ_1	-0.074**	-0.040	-0.176	-0.063	-0.031	-0.068**
	γ_2	-0.05***	-0.434***	-0.511	0.010	0.057***	-0.020**
	$\gamma_1 - \gamma_2$	-0.074	0.394	0.335	-0.073	-0.088	-0.048
MO	γ_1	-0.1***	-0.058**	----	-0.088**	0.052	-0.081***
	γ_2	-0.071***	----	----	----	-0.291***	-0.135***
	$\gamma_1 - \gamma_2$	-0.029				0.343	0.054

Table 3: Piecewise regression results, slope of log-transformed incidence rates * significant at the 10% level ** significant at the 5% level *** significant at the 1% level t-value

Texas was the only SPH state that did not show positive outcome for any of the MSDs analyzed. In California, there was a non-significant increase in the downward trend of carpal tunnel syndrome; non-significant decrease in the upward trend of soreness and pain; and an increase in downward trend of multiple injuries with sprain. Illinois and Washington only recorded an increase in downward trend of sprain/strain and multiple injuries with sprain respectively. Maryland reduced its upward trend of soreness and pain; while New York was able to increase its downward trends of sprain/strain and tendonitis. New Jersey recorded an increase in downward trends of sprain/strain and multiple injuries with sprain; Minnesota recorded the same for carpal tunnel syndrome and tendonitis; Missouri recorded the same for soreness and pain.

Overall, New York, New Jersey, and Missouri recorded non-significant positive outcomes in the form of increase in downward trends of total MSDs.

Model 2- Difference-in-Difference

For all the states tested, the line plots revealed that the MSD trends in the treatment states were similar to those of control states. Figure 5 shows a similar trend in MSD incidence rates for the SPH state (Treatment) and non-SPH states (Control), up to the intervention year. It is assumed, based on this plot, that without the implementation of SPH legislations, the SPH state and non-SPH states will continue to exhibit similar trends in MSD incidence rates. While the two groups were not exactly alike (e.g. for CA and MD pairs), the

trends were in the same general direction. Figure 6 is an example line plot which shows relatively disparate trends in the incidence rates of MSDs. Though SPH state and non-SPH states show a general downward trend in MSD incidence rates up to the intervention year, there are significant differences in the annual trends. Because the overall data shows mostly similar pre-intervention trends between SPH state and non-SPH states, PTA does hold true.

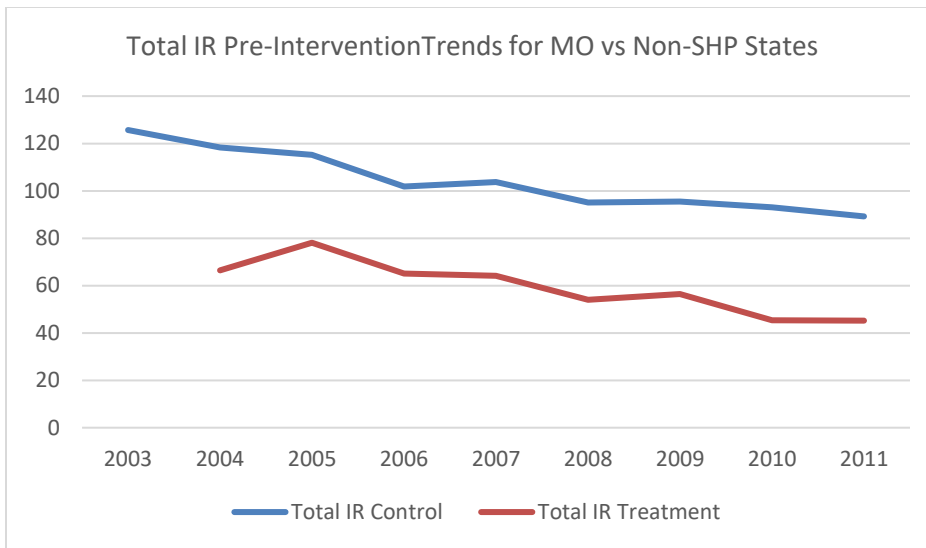


Figure 5: Sample line plot with similar trends of pre-intervention MSD rates between the SPH state and non-SPH states

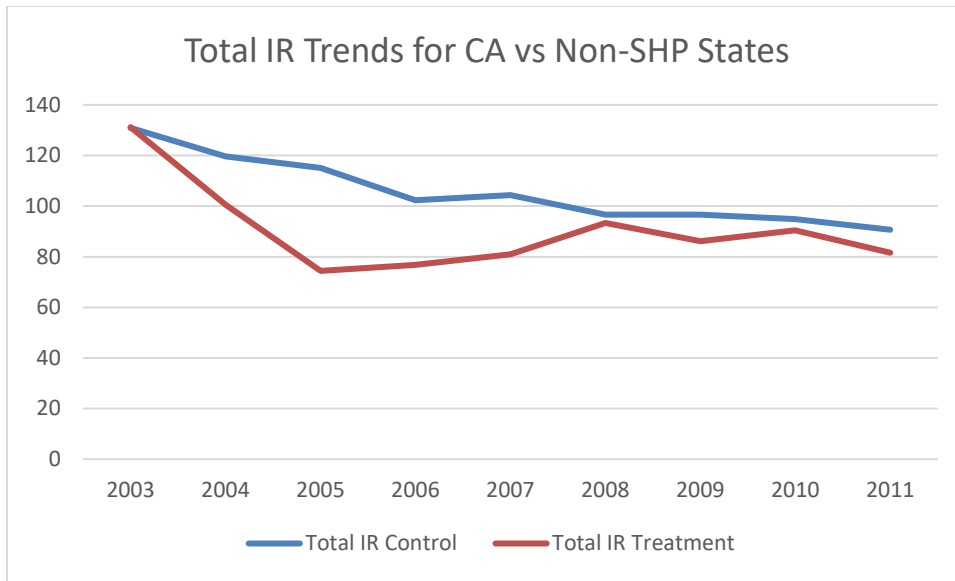


Figure 6: Sample line plot with disparate trends of pre-intervention MSD rates between the SPH state and non-SPH states

Table 4 provides a summary of results of the DiD model for different types of injury by state. For every state, the analysis involved a DiD estimation with the SPH state as the treatment group against all non-SPH states as the control group. Presented in the table are the values for $-\delta$, which represent the combination of time and treatment effects following the implementation of SPH legislations. A negative value indicates a decrease in outcome of interest after intervention. For this study, a negative δ is consistent with a positive effect of SPH legislation. The results indicate significant correlation between the implementation of SPH legislation and reduction in the incidence rates of MSDs (TotalIR) in Texas, Maryland, Minnesota, and Missouri. Tendonitis (in Texas and Missouri); and carpal tunnel syndrome (in Maryland and New Jersey) data were omitted from these analyses due to colinearity.

<i>State</i>	<i>Sprain/Strain (ln)</i>	<i>CTS (ln)</i>	<i>Tendonitis (ln)</i>	<i>MI w/ Spr (ln)</i>	<i>Soreness/pain (ln)</i>	<i>Total IR (ln)</i>
TX	-0.3322***	-0.1107***	----	0.148***	.8314***	-0.226***
	0.72	0.89		1.16	2.3	0.8
CA	0.1622***	0.349**	-0.4408	0.1742***	0.1574***	0.1566***
	1.77	1.42	0.64	1.19	1.17	1.17
WA	-0.0598***	-0.1502***	-0.5712	-0.2218***	1.0088***	0.0078***
	0.94	0.86	0.56	0.8	2.74	1.01
IL	0.1354***	0.1013**	0.8547	-0.719***	0.1344***	0.1281***
	1.14	1.11	2.35	0.49	1.14	1.14
MD	-0.0924***	----	0.6188	-0.2171***	0.5538***	-0.0329***
	0.91		1.86	0.8	1.74	0.72
NY	0.165***	0.1183***	-0.7238***	0.1649***	-0.0575***	0.1899***
	1.18	1.13	0.48	1.18	0.94	1.21
NJ	0.1232***	----	-0.2755*	0.4686***	0.2885***	0.1856***
	1.13		0.76	1.6	1.33	1.2
MN	-0.1376***	-0.5543**	-0.0044	-0.3055***	0.1367**	-0.0859***
	0.87	0.57	1	0.74	1.15	0.42
MO	0.0171***	-0.4412**	----	0.5922***	-0.3166***	-0.076***
	1.02	0.64		1.81	0.73	0.93

Table 4: DiD estimation for all MSDs in all SPH states from 2003 to 2018. * significant at the 10% level ** significant at the 5% level *** significant at the 1% level t-value

SPH legislation is associated with a reduction in the incidence rates of carpal tunnel syndrome (1%/yr) and sprain/strain (2%/yr) in Texas; and sprain and strain (0.5%/yr), carpal tunnel syndrome (1%/yr), tendonitis (4%/yr), and multiple injuries with sprain (2%/yr) in Washington. In California and Illinois, SPH legislation is associated with decrease in the incidence rates of tendonitis (5%/yr) and multiple injuries with sprain (6%/yr) respectively. The reduction in the incidence rates of sprain/strain (1%/yr) and multiple injuries with sprain (2%/yr) in Maryland; tendonitis (13%/yr) and soreness/pain (2%/yr) in New York; and

tendonitis (2%/yr) in New Jersey are all associated with SPH policy implementation. Also, Minnesota showed a decrease in sprain and strain (1%/yr), carpal tunnel syndrome (4%/yr), and multiple injuries with sprain (2%/yr), while Missouri experienced a decrease in the rates of CTS (5%/yr) and soreness/ pain (4%/yr). All these changes are consistent with the states' SPH legislations.

However, contrary to the study hypothesis, there were increases in the incidence rates of multiple injuries with sprain and soreness/pain in Texas; all observed MSDs in California except tendonitis; and tendonitis and soreness/pain in Washington. All observed MSDs in Illinois except multiple injuries with sprain; tendonitis and soreness/pain in Maryland; sprain/strain, carpal tunnel syndrome, and multiple injuries with sprain in New York all showed an upward trend. Results also showed an increase in the incidence rates of sprain/strain, multiple injuries with sprain, and soreness/pain in New Jersey; soreness/pain in Minnesota; and sprain/strain and multiple injuries with sprain in Missouri. All changes were after the implementation of SPH legislation in those states.

Of the nine SPH states analyzed in the study, four demonstrated a decrease in the incidence rates of sprain and strain, CTS, and multiple injuries with sprain following the implementation of SPH policies. Only two states saw a decrease in soreness and pain incidence rates. There was a decrease in tendonitis rates in five states after SPH policy implementation, although three of the results were not statistically significant. Overall, considering the trend of Total Incidence Rate for MSDs, SPH policy implementation is associated with a reduction of HW-MSDs in Texas, Maryland, Minnesota, and Missouri.

DISCUSSION OF SPECIFIC AIM 1 MODELS

This study uses two different models to analyze the effectiveness for SPH legislations. The models generate significantly different results. Model 1 indicates effective SPH programs in New York, New Jersey, and Missouri; while model 2 shows effective programs in Texas, Maryland, Minnesota, and Missouri. This difference may be due to the fact that model 1 (piecewise regression) compares the MSD trend within a population (SPH state) before- and after intervention while model 2 (DiD) accounts for the pre-intervention trends among the SPH state and non-SPH states.

Both DiD and the Piecewise regression estimates revealed, contrary to the proposed hypothesis, varying trends and different levels of significance among the analyzed MSDs from one SPH state to another. Several factors may be responsible for these variations in the impacts of SPH legislations. There are significant differences in the elements, scopes, and levels of enforcement of these policies. Some SPH policies have similar elements, yet different impacts. These differences could be attributed to possible differences in how they are implemented and enforced. Texas and Illinois, for example, require hospitals and nursing homes to establish an SPH policy to identify, assess, and control risks of MSDs related to patient handling (Illinois General Assembly, 2012; Texas Health and Safety Code, 2006) . Both states' policies require an analysis of the risks of injuries to patients and healthcare workers; education of healthcare workers on injury risks; minimizing manual patient

handling; and procedures for nurses to refuse (percieved) unsafe patient handling tasks.

While these two legislative actions are identical in content, the differences in implementation and enforcement could account for the variation in effectiveness.

Given the differences in the scope and stringency of SPH from state to state, and socio-economic differences between the states, there are significant variations in the effeciency of different state's SPH policy. Safe Patient Handling, based on state-level legislation, increases the heterogeneity from state to state. Some states' laws are very similar in text but vary the levels of impact as measured by the incidence rates of MSDs among the states' HW. Other factors such as politics and economy play significant roles in the implementation and effeciancy of SPH. Therefore, setting one national standard to protect healthcare workers from work-related MSDs will be a step in the right direction.

SPECIFIC AIM 2 – SAFE PATIENT HANDLING POLICY ANALYSIS AND DISCUSSION

Health policy analysis is a multi-step socio-political activity which requires many resourses and factors to be considered (Collins, 2005). This study employs the Bardach's eightfold framework of policy analysis. SPH policies in Texas, California, Maryland, Illinois, New York, New Jersey, Minesota, Missouri, Rhode Island, and Washington were analyzed collectively to assess the case for a national SPH legislation.

Texas was the first state to successfully pass SPH legislation in 2006. Illinois, six years later enacted its SPH policy with very similar elements to that of Texas. These laws require

all hospitals and nursing homes to establish an SPH policy, which, at a minimum, includes analysis of injury risks to patients and healthcare workers; education of healthcare workers on the risks of patient handling-related injuries; and an evaluation of alternative risk reduction initiatives (Illinois General Assembly, 2012; Texas Health and Safety Code, 2006). These policies also require applicable facilities to consider the feasibility of incorporating patient handling equipment when planning facility construction or remodelling.

New Jersey enacted the Safe Patient Handling Act in 2008, which requires hospitals and nursing homes to establish SPH programs and committees (New Jersey Code, 2008). The program includes a written policy stating the rights of patients to refuse the use of patient handling equipment and devices. It also includes an SPH equipment need assessment, a three-year plan to purchase this equipment, and training programs for healthcare workers. This policy requires that 50% of committee members be healthcare workers and clearly states the implication of violation of any part of the policy.

In California, the Hospital Patient and Health Care Worker Injury Protection Act was enacted as an addition to the labor code in 2011. This plan required general acute care hospitals to establish safe patient handling policies, provide trained lift teams, and replace manual patient handling with equipment-assisted patient handling (California Labor Code, 2011). A new section was added in 2014, which specified the inclusion of elements such as policy implementation and enforcement plans, procedure for evaluating SPH needs, training requirements, plans for annual policy review, etc (California Labor Code, 2014).

Washington in 2007 required all hospitals to establish a safe patient handling program and committee (Washington State Legislature, 2006) . The committee, half of whose members were to be firstline non-managerial direct patient care employees, would design and recommend the process for implementing a safe patient handling program. The safe patient handling program, among other requirements, required the hospital to conduct needs assessment and patient handling hazards assessment. It also requires hospitals to consider the feasibility of incorporating patient handling equipment during facility construction or renovation. One unique fact about this policy is that it requires an annual performance evaluation of the program to determine its effectiveness.

Maryland enacted its SPH policy in 2007. Centered around the use of mechanized- instead of manual patient handling, this policy requires an SPH committee to consider the appropriateness of patient handling devices, training programs, and the feasibility of incorporating patient handling equipment during facility construction or renovation (Maryland General Assembly, 2007). This policy, like that of Washington, also requires an evaluation process to determine policy effectiveness.

Title 1-A (Safe Patient Handling), Article 29-D was added to New York Public Health Law by Chapter 60 of the Laws (New York State Assembly, 2014). This legislation mandated the constitution of an SPH Workgroup by the Commissioner. This workgroup was responsible for reviewing existing SPH policies, consulting with relevant institutions, and developing appropriate training materials for consideration by health care facilities. This policy also requires every healthcare facility to establish an SPH committee, which would

design and recommend the process for implementing a safe patient handling program for the facility. Every healthcare facility, with the help of the committee, are required to establish a safe patient handling program which involves, among other elements, SPH policy implementation, patient handling hazard assessments, and conduct an annual performance evaluation of the program to determine its effectiveness.

The Minnesota SPH Program was established in 2007 with the goal of minimizing manual lifting of patients by utilizing safe patient handling equipment (State of Minnesota, 2007). Addressed under this program are patient handling hazard assessment, SPH equipment supply, training needs, and annual evaluation of the program. The SPH committee helps in the establishment and implementation of the program. Unlike the previously mentioned laws and Codes, this program addresses its enforcement by the commissioner, and the penalties attached to its violation. Also, Minnesota, through this program, makes grants available to healthcare facilities for acquiring SPH equipment and for training.

In 2015, Missouri enacted the Safe Patient Handling and Movement Act. Like California, this legislation is established as a part of the injury and illness prevention program, required for every hospital in the state (California Labor Code, 2011; Missouri General Assembly, 2015). Functional elements include a written policy, training on proper use of patient handling equipment, and protection of employees from any disciplinary actions for refusing unsafe patient handling tasks. A unique feature of this legislation is that it clearly and specifically states the implications of- and penalties attached to its violation.

Rhode Island passed its SPH law in 2006, which required all licensed healthcare facilities in the state to establish an SPH committee and a written program (Rhode Island General Laws, 2006). Like other states' legislation, it required healthcare facilities to conduct a patient handling hazard assessment, designate and train appropriate employees on proper use of SPH equipment, and conduct an annual performance evaluation of the program.

Despite the enactment of some form of Safe Patient Handling law in about 20% of U.S. states, the healthcare industry has experienced a significant turnover of nurses, nursing assistants, and other healthcare workers due to musculoskeletal disorders resulting from repeated manual patient lifting. MSDs remain prevalent among HW nationwide (Pompeii, Lipscomb, & Dement, 2008). Workers' compensation claims, disability claims, and general (direct and indirect) costs of manual patient lifting remain high (Lee, Lee, & Gershon, 2015). Given the effectiveness of these policies in the individual healthcare facilities, an enactment of a National Safe Patient Handling policy will help reduce the incidence of HW-MSDs.

This study is a combined analysis of existing SPH policies in the aforementioned states with the goal of making a case for a national policy. The eight-step framework for effective problem solving, used for this evaluation, included problem definition, presenting evidence, considering policy alternative, defining the standards for intervention evaluation, projecting intervention outcomes, confronting any trade-offs, making decision, and sharing the results.

1. Problem:

Despite all advances in technology and relentless efforts of researchers over the years, MSDs remain prevalent among HW with patient handling being a major risk factor.

The CDC defined MSDs as soft-tissue injuries that result from either acute or chronic exposure to repetitive motion, force, vibration, or awkward positions (Centers for Disease Control and Prevention, 2018). Examples of MSDs common in healthcare environment include sprain, strain, carpal tunnel syndrome, and back pain. Work-related MSDs pose a major stressor, not only to the employee, but to other agents such as the employer, insurance provider, governments, co-workers, and even family members.

The states of New Jersey and California defined patient handling in their legislation as processes and tasks that involve lifting, transferring, repositioning or mobilizing of part or all of a patient's body (California Labor Code, 2014; New Jersey Code, 2008). Healthcare workers such as nurses, nursing aides, patient care technicians, occupational therapists, etc., perform these tasks on daily routine bases. These activities constitute major risk factors of MSDs in the healthcare sector (Kim, Dropkin, Spaeth, Smith, & Moline, 2012) with effects ranging from minor discomforts to billions of dollars in workers' compensation costs annually (*Oregon OSHA reports and statistics*.2012; *Texas department of insurance safety information systems*.2017; Lee et al., 2015).

The costs of patient handling-related MSD are paid by:

- The employee with his/her health and lost workdays and wages.
- Family members, who might need to sacrifice time and other resources.

- Employer that may need to spend resources in employing and training replacement; may face potential law suit; and may be subjected to government sactions and fines.
- Insurance provider that carries financial responsibilities for medical care.
- Coworkers who may be burdened with extra tasks to pick up the slacks.
- The government that carries the burdens of workers' compensation claims.

Various studies of MSDs in healthcare facilities with SPH policies have reported significant reduction in MSD incidence rates among healthcare workers following the implementation of these policies. Many states have enacted different versions of safe patient handling legislation and many efforts have been made by different health care facilities to control MSD hazards in hospitals. However, evidence show that MSDs still remain prevalent among healthcare workers on the national scale.

2. Evidence

Epidemiological studies have linked more than 30% of all musculoskeletal injuries in the healthcare sector to patient handling, with most of the burden among nurses' aides, housekeepers, dietary services, radiology technicians, and inpatient nurses (Pompeii et al., 2008). In 2011, MSD incidence among healthcare workers was seven times the national rate compared to all industries (Ann Adamczyk, 2018). In a study to investigate the trends of patient handling related MSDs in hospital settings using workers' compensation claims data, 76% of such claims were identified as MSDs, about half of which was patient handling related (Kim et al., 2012). A similar study associated patient

handling injuries with 72% of MS injuries and 53% of workers' compensation costs among patient care employees (Lipscomb, Schoenfisch, Myers, Pompeii, & Dement, 2012).

Patient handling also contributed significantly to reduction in the level of job satisfaction and high turnover among nurses (Aslam, Davis, Feldman, & Martin, 2015). Some other studies reported the financial burden of patient handling related MSDs. Workers' compensation claims cost the state of Oregon over \$54 million in 2010 with an average of \$16,930 per claim (*Oregon OSHA reports and statistics*.2012). The cost of workers' compensation claims to Washington State was estimated at, approximately, \$33 million annually (Lee et al., 2015). A recent report by the Texas Department of Insurance indicated (2017), a total of 6,711 workers' compensation claims from the healthcare sector in 2016 with an average of \$11,633 per case.

3. Policy Alternative

While evidence suggests that MSDs remain a national risk among the healthcare workforce, SPH initiatives have been proven to be effective in facilities that have implemented them (Burdorf, Koppelaar, & Evanoff, 2013; Kurowski et al., 2017; Powell-Cope et al., 2014; Zadvinskis & Salsbury, 2010). This contradiction is due to the overwhelming number of facilities without SPH programs across the country. This problem can be addressed by implementing a national SPH policy, integrating different elements of the existing state policies.

The rationale behind this policy evaluation is rooted in the fact that there is evidence from published studies that healthcare facilities that implemented SPH policies experienced reduced rates of MSDs with increase in cost savings. If these positive impacts are seen at the facility level but not on the state or national scale, it is because the impacts have been absorbed by the relatively large number of facilities without SPH policies.

A national policy will help set a minimum standard for the healthcare workers' protection against MSDs. Although individual states may set their standards as high as manageable, setting a minimum national standard will either motivate or create regulatory requirements to press non-SPH facilities and states into action. Such action will, on a larger scale, increase the rate of reduction of MSDs among the US healthcare workforce.

The elements of this act are selected from different states' SPH legislation. Table 5 shows a summary of the different state's SPH laws. Though the Minnesota SPH program is used as a template, a few other elements are adopted from other SPH programs. There is a need to protect employees who refuse to perform unsafe patient handling tasks. Such need is addressed in some other states' law but not in Minnesota. The Minnesota SPH program seeks to minimize the use of manual patient handling. This part of the policy is not enforceable because the term "minimize" is subjective and can be interpreted differently by different facilities. Replacing manual patient handling with mechanized patient handling can be

enforced and is therefore adopted. Also, to facilitate this replacement, lift teams will be defined as employees trained to safely use patient handling devices.

<i>Elements</i>	<i>TX</i>	<i>CA</i>	<i>WA</i>	<i>IL</i>	<i>MD</i>	<i>NY</i>	<i>NJ</i>	<i>MN</i>	<i>MO</i>	<i>RI</i>	<i>National Prototype</i>
<i>Committee</i>			X		X	X		X		X	X
<i>Training</i>	X	X		X	X	X	X	X	X	X	X
<i>Replace manual- with mechanized PH</i>		X	X		X				X	X	X
<i>Minimize manual PH</i>	X			X				X			
<i>Lift team</i>		X*	X*	X*	X				X*	X	X
<i>Procedures to refuse unsafe tasks without punishment</i>	X	X	X	X		X	X		X	X	X
<i>Enforcement</i>							X	X	X		X
<i>Incorporating equipment installation into construction</i>	X		X	X	X	X		X			X
<i>Program Evaluation</i>			X		X	X	X	X	X		X
<i>Financial Incentives</i>								X			X

Table 5: Summary of all existing SPH laws in the United States. *Lift teams are employees trained to safely operate SPH equipment

This proposed national policy has the following broad sections:

- *Name of the act:* National Safe Patient Handling Act
- *Definitions:* All terms, technical or not, are defined to prevent ambiguity.
Definitions for relevant terms are taken from different states' legislation.
- *Written Policy:* This section states the need for a written policy, and the need for such policy to be readily available to all stakeholders when needed. With this

written policy, an SPH committee will be constituted and the SPH program will be established.

- *SPH Committee:* This section specifies the need for- and the duties of an SPH committee. Some of such duties include patient handling hazard assessments, need assessment for patient handling equipment, training recommendation and development, and SPH program evaluation, among others. The committee will see to proper implementation of the program.
- *Program requirements:* This is where the minimum requirements for the SPH program are highlighted. For example, the program not only requires that the need for SPH equipment be assessed, it also requires the plans for procuring them. It also explains the training requirements like the minimum contents of training materials, assessing employees' proficiency, and frequency of training.
- *Enforcement:* This section explains the penalties of violating any part of this act. These penalties will help drive program implementation and ensure compliance by healthcare facilities. It also highlights employees' protection against any form of punishment for refusing an unsafe patient handling task.
- *Financial incentives:* Implementing SPH program is capital-intensive. Such an initiative may, therefore, be very difficult for some facilities to achieve. Incentives like grants and interest-free loans will provide significant financial help for facilities in need of such help. Tax credits for effective SPH programs will help maintain program sustainability.

Appendix A is a draft of the National Safe Patient Handling Act.

4. Standards for Policy Evaluation

Bardach (2016) identified different criteria that can be used in policy evaluation. Some of these criteria include cost, efficiency, sustainability, administrative feasibility etc. This policy was evaluated based on its efficiency and cost-effectiveness.

Various kinds of studies have been conducted to evaluate the effects of SPH policies. One of such studies involving the staff of a critical care medical unit in a Michigan hospital, reported 86% and 54% annual reductions in work-related MSDs and lost/restricted work days respectively (Ann Adamczyk, 2018) . A hospital in Wisconsin recorded a 60% reduction in injury-related direct costs, 36% decrease in the number of injuries, and 71% reduction in lost work days within a year of SPH implementation (Stevens, Rees, Lamb, & Dalsing, 2013). An evaluation of the SPH program at a pediatric hospital in Minnesota indicated a 71.4% reduction in post-intervention patient handling-related injuries, compared with pre-intervention (Haglund, Kyle, & Finkelstein, 2010)

In 2008, the Veterans Health Administration (VHA) implemented an enterprise-wide SPH program (Rugs et al., 2013) . A three-year longitudinal study of the Veterans Health Administration's SPH program revealed a 1.5 unit decrease in

MSDs with every 1% increase in the number of ceiling lift deployed throughout the enterprise (Powell-Cope et al., 2014). Other studies on the evaluation of VHA's SPH program indicated a 74% reduction in workers' compensation costs, with a 30% reduction in annual work-related injury rates (Nelson et al., 2006) .

5. Projected outcome of Policy Option

As indicated in figure 2 above, the overall outlook of MSDs from 2003 to 2018 shows a downward trend among US healthcare workers. Some states show steady reduction while others show irregular trends. Even among the SPH states, trends remain irregular within the period covered by this study. The results of the analyses in the first part of this study show different levels of impact of SPH programs among the SPH states; some with and others without positive effect. Despite these irregularities in SPH outcomes at the state and national levels, one fact remains constant, SPH programs are effective at the grassroots (facilities level).

As explained above, several studies have been conducted and published that associated implementation of SPH programs at different facilities with significant reductions in MSD incidence rates, and lost or restricted workdays. Other facility-based studies have linked SPH implementation to increase in job satisfaction among healthcare workers and increase in cost savings for the facility. It is, therefore, projected that a well implemented and enforced national safe patient handling act will produce similar results as they do at the grassroots (facility level).

This act is projected to reduce MSD incidence rates among US healthcare workers. Implemented by healthcare facilities in all states across the country, it will be instrumental in reducing the number of lost/restricted workdays; increase efficiency and job satisfaction among healthcare workers; and increase cost savings for the facility. Although implementing SPH may be expensive, a study estimated a 100% return on investment in less than four years, with an annual cost savings of over \$200,000(Nelson et al., 2006)

6. Confronting Trade-Offs

The cost of establishing SPH could pose a hindrance to the acceptance of this act while the operation costs could negatively affect its sustainability. The incorporating of financial incentives into the act will help alleviate potential fiscal constraints and motivate healthcare facilities to implement the program. Overall, with incentives to help establish and sustain, and specific instructions to establish, operate, and enforce it, the national safe patient handling act is projected to significantly reduce the incidence of HW-MSDs.

From the employees' perspective, implementation of SPH policy may result in deviations from the routine, which may in turn cause some level of inconvenience for healthcare workers. Patient safety, work satisfaction, and overall quality of work may be negatively affected at the introduction of the program. However, adequate training, as specified in the proposed Act (see appendix A), and time will help assuage such issues and concerns. With time, proper implementation and reinforcement will

improve mastery and policy acceptance by the end-users, i.e. direct patient care employees.

The cost of the proposed financial incentives may be frowned upon by policymakers, but the expected returns are worth the investment. The government is expected to spend millions of dollars in grants to help some facilities kickstart their SPH programs. A significant amount is also expected to be invested in tax credits as a positive reinforcement for effective program operation. However, with time, returns are expected on these investments in the form of diminishing incidence rates of MSDs among healthcare workers and cost savings on workers' compensation claims.

7. Decision Making

Given all evidence referenced in this study, and the fact that the alternative to this national policy is the status quo; a decision to enact national safe patient handling legislation will, in the long run, benefit every stakeholder.

8. Presenting the Results of the Process

Appendix A is a draft of this proposed policy.

CONCLUSION

The results of the above analyses revealed distinct variations in the possible effectiveness of Safe Patient Handling Legislation in different states across the country, as shown by trends of association. These legislative actions were observed to be associated with improvements in Texas, Maryland, Minnesota, and Missouri. Economic and fiscal capability varies among different states. Therefore some facilities may have limited resources with limited government support to fully and effectively implement the SPH policy. Noteworthy and very important is the fact that these policies are state-level policies, hence the differences in policy elements and variations in the observed results.

Setting a national minimum standard for safe patient handling will synchronize the efforts and better control HW-MSDs. Although policy implementation will be at facility level, enforcement will be by a federal agency and implementation will be supported by the federal government.

The status quo is a condition in which less than 25% of the country's healthcare facilities have programs or policies protecting workers from patient handling related MSDs, which remained prevalent across the country. It is a situation in which, among SPH states, evidence points toward varying levels of impacts of the SPH programs at the state level. The status quo is also a state where some facilities that have implemented these programs have reported significant positive effects within the first few years of the program. Safe patient handling policies have been associated with reduction in the incidence rates of patient

handling related MSDs; reduction in the number of lost and/or restricted workdays; and cost savings from workers' compensation and disability claims at the facilities level.

The success of the SPH policy at the grassroots, coupled with the need minimize the incidence of MSDs among direct patient care workers have motivated the need to implement a national legislation. Combining different elements from the various states' SPH policies will help set a minimum standard, strong enough to yield the desired outcomes.

Study Limitations

- There were threats to this study's internal validity. One of such threats is posed by the effects of external factors such as economic changes and administrative changes within facilities. Use of DiD estimation and satisfying the PTA would help control some of these threats. Potential threats by selection bias will be controlled for by including every one of the 10 treatment states individually matched with all available control states.
- This study only includes 33 of 50 states (66%) due to limited data availability. Some states were excluded either because they did not report any injury and illness data to the BLS or because the reported data were incomplete. This constraint poses a threat to external validity as results may not be generalizable to other states excluded from the study.
- The SPH policies differ in scope, elements, and enforceability from state to state. Some of these differences may be due to differences in state's fiscal status, social and

political ideologies, and other factors. All these factors pose threats to external validity of the study. The inclusion of all states with SPH policy will reduce the effects of these individual differences; hence controlling the threats to external validity. This model will not only help in testing the PTA, it will help control for the potential effects of economy and socio-political ideologies and reduce the threats to internal validity.

- Data used in the study are state level data. This fact made it impossible to control for policy effectiveness at the facility level or control for potential confounders such as healthcare workers' age, race, gender, level of education, etc. Also, due to the wide range of intervention years among SPH states, a combined analysis of all SPH states was inappropriate. Therefore, testing the effects of policy differences among SPH states was impossible. It is recommended that subsequent studies make use of facility-level individual microdata for more specific analyses.
- Also, the DiD and piecewise regression models can only control for observable differences between controls and cases and over time. There may be some unobservable differences that are related to outcome that could bias the results.

APPENDICES

Appendix A: Proposed National Safe Patient Handling Act

Section 1

This act will be known as National Safe Patient Handling Act

Section 2: Definitions

“Health care worker” means an employee responsible for performing or assisting in patient handling activities, who is specifically trained to handle patient lifts, repositioning, and transfers using patient transfer, repositioning, and lifting devices as appropriate for the specific patient.

“Emergency” means unanticipated circumstances that can be life-threatening or pose a risk of significant injuries to the patient, staff or public, requiring immediate action.

“Equipment” means a powered or non-powered device that effectively reduces the forces exerted by or on employees while they perform patient handling activities, including all accessories necessary for the operation of the device. Devices and accessories include replaceable and disposable items.

“Lift team” means designated health care workers specifically trained to work together to perform patient handling activities using equipment as appropriate for the specific patient.

“Lifting” means the vertical movement of a patient or the support of part or all of a patient's body.

“Manual patient handling” means the lifting, transferring, repositioning, or mobilizing of part or all of a patient's body done without the assistance of equipment.

“Mobilizing” means the putting into movement, or assisting in the putting into movement, of part or all of a patient's body.

“Musculoskeletal injury” means acute injury or cumulative trauma of the muscles, tendons, ligaments, bursa, peripheral nerves, joints, bone or blood vessels.

“Patient” means a person who is receiving diagnostic, therapeutic or preventive health services or who is under observation or treatment for illness or injury or for care during and after pregnancy.

“Patient handling” means lifting, transferring, repositioning or mobilizing of part or all of a patient's body.

“Repositioning” means changing a patient's position on a bed, gurney, chair or other support surfaces.

“Safe patient handling policy” means a policy that requires replacement of manual lifting and transferring of patients with powered patient transfer devices, lifting devices, and lift teams, as appropriate for the specific patient and consistent with the employer's safety policies and the professional judgment and clinical assessment of the registered nurse.

“Transferring” means moving a patient from one surface to another (for example from a bed to a gurney).

Section 3: Safe patient handling policy.

(A) Every healthcare facility shall establish a safe patient handling policy;

(B) Post the safe patient handling policy in a location easily visible to staff, patients, and visitors; and

(C) Designate a representative of management at the facility who shall be responsible for overseeing all aspects of the safe patient handling program.

Section 4: Safe patient handling committee.

(A) Every health care facility shall establish a safe patient handling committee either by creating a new committee or assigning the functions of a safe patient handling committee to an existing committee.

(B) A safe patient handling committee shall:

(1) Complete a facility-wide patient handling hazard assessment that:

(i) Considers patient handling tasks, types of nursing units, patient populations, and the physical environment of patient care areas;

(ii) identifies problems and solutions;

(iii) Identifies areas of highest risk for lifting injuries; and

(iv) recommends a mechanism to report, track, and analyze injury trends;

(2) make recommendations on the purchase, use, and maintenance of an adequate supply of appropriate safe patient handling equipment;

(3) make recommendations on training of health care workers on the use of safe patient handling equipment, initially when the equipment arrives at the facility and periodically afterward;

(4) conduct annual evaluations of the safe patient handling implementation plan and progress toward goals established in the safe patient handling policy; and

(5) recommend procedures to ensure that, when remodeling of patient care areas occurs, the plans incorporate safe patient handling equipment or the physical space and construction design needed to accommodate safe patient handling equipment at a later date.

Section 5: Program Requirements

(A). A safe patient handling program shall include:

(1) a written safe patient handling policy on all units and for all shifts that minimizes unassisted patient handling, taking into account the patient's physical and cognitive condition, and that is consistent with patient safety and well-being;

(2) an assessment of the safe patient handling assistive devices needed to carry out the facility's safe patient handling policy;

(3) protocols and procedures for assessing and updating the appropriate patient handling requirements of each patient of the facility;

(4) a plan for achieving prompt access to and availability of mechanical patient handling equipment and patient handling aids;

(5) a training program for health care workers that -

- (a) covers the identification, assessment, and control of patient handling risks; the safe, appropriate, and effective use of patient handling equipment and aids, and proven safe patient handling techniques;
- (b) requires trainees to demonstrate proficiency in the techniques and practices presented;
- (c) is provided during paid work time; and
- (d) is conducted upon commencement of the facility's safe patient handling program and at least annually thereafter, with appropriate interim training for individuals beginning work between annual training sessions; and
- (6) educational materials for patients and their families to help orient them to the facility's safe patient handling program.
- (7) Annual performance evaluation of the program to determine its effectiveness.
- (B). Nothing in this act shall be construed to limit the right of a patient to refuse the use of assisted patient handling.

Section 6: Enforcement.

- A. Any hospital that violates the provisions of this section shall be subject to a civil penalty of up to five thousand dollars a day for each day of such violation and for each act of violation. If the hospital fails to comply with the provisions of this section within five consecutive calendar days of a cited violation, the civil penalty under this subsection shall increase to ten thousand dollars a day for each day of continued violation.
- B. Any person who is discharged, discriminated against, retaliated against, or who is otherwise harmed by a violation of this section, including any nurses, patients, or other

persons who are adversely affected, exposed to risk of harm, or suffer actual harm caused in whole or substantial part by the violation complained of, may file a civil action for appropriate injunctive relief or recover the following:

- (1) Actual damages, including medical care, hospitalization, rehabilitation, and reimbursement of lost wages and benefits damages;
- (2) Punitive damages;
- (3) Court costs; and
- (4) Reasonable attorney's fees.

C. A hospital shall develop procedures for hospital employees to refuse to perform or be involved in patient handling or movement that the hospital employee believes in good faith will expose a patient or a hospital employee to an unacceptable risk of injury.

Section 7: Financial Incentives.

(A) The government shall make grants available to health care facilities to acquire safe patient handling equipment and for training on safe patient handling and safe patient handling equipment. Grants to any facility may not exceed \$40,000. A grant must be matched on a dollar-for-dollar basis by the grantee. The government shall establish a grant application process. The government may give priority for grants to facilities that demonstrate that acquiring safe patient handling equipment will impose a financial hardship on the facility. For health care facilities that provide evidence of hardship, the 50 percent match requirement may be waived; and such a facility may be granted more than \$40,000.

(B) Tax Credit shall be available to healthcare facilities that present evidence of a reduction in Musculoskeletal Disorders (MSDs) for the previous year. For example, if a healthcare facility requests tax credit in a specific year, such a facility must present valid evidence of reduced MSD incidence rates from the previous year. Every facility will be eligible for this tax credit for every annual decrease in work related MSDs incidence rates.

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