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Intervention Policy Effectiveness in Incident Rate Reduction in General Manufacturing: A Case Study

Meredith Dentice Johnson and Naira Campbell-Kyureghyan

University of Wisconsin – Milwaukee
Consortium for Advanced Research in General Industries (CARGI)
College of Engineering and Applied Science

Corresponding author's Email: mdentice@uwm.edu

Abstract: Safety interventions are implemented post injury in most general manufacturing settings, and in some cases the effectiveness of these interventions is not evaluated. The amount of time and effort put into said interventions may be limited due to priorities of resource availability. This can ultimately lead to ineffective interventions and untested solutions. Particularly, strict clothing policies (other than PPE) may be a go to solution that is implemented in order to protect employee's body parts from injuries and often without clear understanding of the underlying reasons or specific justifications. The main goal of this study was to conduct a case study and investigate the effectiveness of some specific clothing-related policies in general manufacturing through determining if the policy change had any influence on plant incident rate and the overall number of incidents.

A study was conducted to analyze a particular policy change implemented at a manufacturing facility in Wisconsin. The new policy banned employees from wearing shorts inside the facility in an effort to improve employee safety and reduce incidence rates. The incident occurrences from 2 years before and 2 years after the policy change were collected and analyzed. The data set consisted of: recordable injuries, non-recordable injuries, and near misses from the plant's 600 shop floor and office employees dispersed over three shifts.

A comprehensive injury data analysis showed that the overall number of incidents decreased by 7.2% after the new clothing policy was implemented. However, the policy change did not have an overall significant effect (p = 0.92) in reducing the total number of incidents that took place 2 years after its implementation. In addition, 72.1% of incidents, within that four year period, with the injury body part affected disclosed were related to an upper extremity and thus the implemented clothing policy may not have been effective in injury prevention or injury severity reduction.

The policy change was seen as a tangible way to improve safety, but due to the lack of root cause analysis or any investigation to back that claim it failed to serve its purpose.

Keywords: Occupational Safety, Intervention Effectiveness, Policy Implementation

1. Introduction

Many companies focus on improving profit margins through allocating resources to cost saving and productivity improvement projects rather than investing in safety programs and effective safety interventions. According to the United States Department of Labor, over one million dollars in fines were paid to the Occupational Safety and Health Administration in Wisconsin alone in 2018 for a plethora of safety violations that could have been easily prevented ('United States Department of Labor'). The corporate world responds to these fines by implementing safety interventions quickly while utilizing minimal costs and hoping for a high return on investment. In addition, social norms may pressure companies into quick fixes. For example, children should wear safety helmets to prevent injuries when biking, but did every parent that had their child wear a helmet actually believe it will prevent injuries? Or did they tell their child to wear the helmet because society said they should (Aldred and Woodcok, 2015)? Companies may mimic this analogy, if they have lots of safety policies and procedures their company must be safe, and the public eye should view it that way.

Safety intervention effectiveness is not often scientifically or practically proven, although, there are case studies that discuss approaches that may be favorable. Implementing post injury interventions is only one piece of the puzzle. Many companies forget the other pieces – one of which is ensuring the intervention is effective. Effectiveness should be statistically and practically appropriate as overly complex solutions and polices may lead to more accidents indirectly (Koster, Sstanm & Balk, 2011). Dress code policies and personal protective clothing are two different things. Personal protective equipment effects are often favorably proven. The supporting literature often links specific personal protective equipment or polices to a specific hazard or set of circumstances. The National Fire Protection Association (NFPA) and the Institute of Electrical and

Electronics Engineers (IEEE) performed a favorable systematic review and determined which personal protective equipment is most effective for arc flash protection based on hazard assessment methodologies (Doan, Floyd, & Neal, 2004). The clothing itself or policy should be reasonable and be intended to protect against the different hazards for that specific situation that that person may encounter. For example, protective clothing for personnel working in cold and wet conditions should undergo specific testing that focuses on hazard responses resulting from cold/wet immersion (Faerevik, 2000). Another example is how healthcare professionals are required to regularly launder their uniforms or attire to remove or kill any bacteria that may have grown on it in order to eliminate the risk of spreading anything (Wilson et al., 2007). These policies or clothing requirements are tied to specific hazards and circumstances. The external validity of the references that warrant a policy implementation also needs to be taken into consideration and generalizations of approved clothing should not be applied universally.

The main goal of this case study is to evaluate whether the clothing policy change had an influence on incident rate of injuries and the overall number of incidents occurrences. The following research question is posed: how effective is an administrative control clothing policy intervention in a general manufacturing work setting? The potential responses to this question will aid in supporting the hypothesis conclusion. The authors hypothesized that in this particular case the clothing policy change as an administrative control will have no effect on the incident rate of injury or the overall number of incident occurrences.

2. Methods

2.1 Materials

In this retrospective cohort study, safety incidents were occurring, and a safety solution was implemented to assist, but the intervention was not previously proven and/or tested for effectiveness (the policy's ability to reduce the overall plant incident rate). The intervention was a clothing policy implemented in a general manufacturing facility in Wisconsin that required all employees to have their legs completely covered (i.e. wear pants, leggings, etc.) in the manufacturing facility in order to protect legs from injuries.

A memorandum was sent out by the Human Resources Department approximately one week prior to the policy effective date of 04/15/2016 indicating the change and all policies and handbooks were updated to reflect it. All employees were told about the policy by their direct supervisor and needed to sign a form indicating that they acknowledged there is a new policy to which they must adhere. The policy did have a clause that it could be altered on a case by case basis.

Manufacturing tasks within the plant include wiring control boxes, building fan assemblies, winding coils, core cutting and stacking, small parts welding and fabrication, and tank assembly. Because each unit is a custom order, tasks may be similar, but are not standardized or identical. The entire manufacturing facility requires and provides (or compensates employees for) steel toe shoes and safety glasses or side shields with safety prescription lenses. Additional personal protective equipment is required and provided on a task per hazard basis.

There are a few situations that warrant a special white suit to be worn while being performed. The white suit is clean and worn to prevent contamination/make any particles apparent. The suit is put over the employees clothing and is short sleeved but covers the employee's legs completely. Shoe coverings (shoe booties) are also placed over the employee's shoes. Although the suit is thin it may act as "pants" and this population of employees may be unaffected by the policy change. The tasks requiring the suit include drop in, encasement, internal wiring, and internal cleaning. In addition, quality assurance employees wear the suits when inspecting each of the four tasks requiring the suit. Each of these tasks happens once per unit or approximately 250 times per year. The employees who work in the Final Assembly and Shipping Departments perform these tasks. Although only a few employees in the department perform the task on each unit, each employee in the department may be assigned this task so the entire population of these departments will be reviewed to determine if this is affected by the policy.

2.2 Data Collection

This retrospective cohort case study looks into incident occurrences from 2 years before and 2 years after the policy change. The policy was implemented on 4/15/2016 so all incident dates included fell between 04/15/2014 and 04/15/2018. This time period of 4 years is an ample amount of time to showcase an effect from the policy change and involves reviewing the same amount of time before and after the change. The data set consisted of: recordable injuries and non-recordable injuries from the plant's 600 shop floor and office employees dispersed over three shifts.

Employees are required to report any incident that results in injury or property damage. All injury data was entered into an Environmental, Health, and Safety database within twenty-four hours of the incident occurrence by the employee's direct supervisor or another supervisor in the event that the direct is unavailable. Injury data is recorded in a Microsoft Access database. Recordable and non-recordable injuries are defined by the Occupational Health and Safety Administration (OSHA). A corrective action meeting must occur within 48 hours of the incident when possible. All applicable parties (the EHS manager, department supervisor, the employee, any witnesses, and the department manufacturing engineer) are at the meeting and needed corrective actions are decided upon at that time. The corrective actions and root cause details are entered into the database.

The query output, in the form of a Microsoft Excel spreadsheet, provided all incidents including fire, property damage, near misses, recordables, and non-recordables from January 15, 2008 to January 16, 2019. In order to perform data analysis appropriate to the goals of the study, the data was filtered, sorted and coded. All information not pertinent to the study goals was deleted from the spreadsheet. The cost per injury data was not available for the reported incidents therefore cost benefit analysis was excluded from this study. After the data was sorted it was then coded (see Table 1). Incident categories were coded when feasible and uncoded data points were not used in any applicable analyses. Note that for the body part categories, both left and right side of the body elements were treated the same (i.e. left ankle and right ankle were both coded as a lower extremity).

Table 1. Data Coding Sample

Code	Level 1	Level 1 Details	Level 2	Level 2 Details
Policy Status	Before	04/15/2014 to 04/14/2016	After	04/15/2016 to 04/15/2018
Season	Warm	September, October, November, December, January, February	Cool	March, April, May, June, July, August
Body Part Category	Lower	Ankles, Feet, Internal, Calves, Hips, Knees, Thighs, Lower Back	Upper	Abdomen, Ribs, Chest, Head-Chin/Ears/Mouth/Neck/Scalp, Arms, Forearms, Elbows, Fingers, Thumbs, Wrists, Hands, Eyes, Shoulders, Upper Back
Department Category	Final Assembly & Shipping	Department # A, B, C, D	All Others	All Other Departments

After data coding was complete, sorting was again performed to ensure all data points were within the scope of the study goals. All property damage, fire, near misses or unspecified incident type data points were excluded.

2.3 Subjects

An average of 423 employees, from the four year period snapshot, in the facility work on the shop floor in the manufacturing facility areas which is the population pool from which most plant incidents originated. A small percentage of incidents involved office personnel who do not visit the manufacturing floor often, if ever. Between April 15, 2014 to April 15, 2018 the office personnel headcount ranged between 100 to 150 employees, and varied year-to-year.

2.4 Data Analysis

The two independently tested response variables are the total number of incident occurrences and the occupational injury incident rate. The OSHA recordable incident rate is based solely on recordable data and is calculated as follows:

OSHA Recordable Incident Rate = (# of Recordable Cases X 200,000)/# of Labor Hours.

Microsoft Excel Software was used for all calculations. Normality and variance homogeneity is assumed.

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One way ANOVA was performed for testing the hypothesis with a significance level set at 0.05. Relative risk was calculated to showcase intervention effectiveness, with values less than one indicating the policy was protective against injuries and values greater than one indicating the policy was adding to injuries, with the magnitude of the effect indicated by the distance from 1.0.

3. Results

The shop floor headcount stayed fairly stable with an employee changeover rate of 2% when looking at the four year period of April 15, 2014 to April 15, 2018 (Table 3). On average, 28% of the work force performs tasks in the Final Assembly and Shipping Department. Those are the departments that perform tasks requiring the white suit (that covers the lower extremities) to be worn. It is expected that these two departments have fewer incident occurrences overall when compared to the remaining departments because the number of people in these departments is smaller. Both the Final Assembly and Shipping Departments as well as All Other Departments had an overall decrease in the total number of incident occurrences after policy implementation (Table 2). However, the one-way ANOVA performed shows that there is no statistically significant difference in the number of incident occurrences by department before and after the policy implementation ($p = 0.197$).

Table 2. Incident Occurrences by Department and Policy Implementation

		Department and Policy Implementation			
		Before - Final Assembly & Shipping	After - Final Assembly & Shipping	Before - All Other Departments	After - All Other Departments
Time Period	4/15/14 - 12/31/14	25	0	82	0
	2015	27	0	88	0
	2016	2	12	21	60
	2017	0	20	0	100
	01/01/18- 04/15/18	0	3	0	24
	Total	54	35	191	184

Table 3. Average Number of Employees

Year	Final Assembly & Shipping	All Others	Total	% Change
2014	77	315	392	
2015	84	319	403	3%
2016	92	332	424	5%
2017	113	304	417	-2%
2018	93	339	432	3%

The OSHA recordable incident rate was essentially unaffected by the policy change. The average rate before the policy was implemented was 4.53 compared to the rate of 4.46 after, resulting in less than a one percent change. The plant rate fluctuated from year to year and did not follow a defined trend between 2014 and 2018 (see Figure 1). When comparing the total number of incidents 2 years before and after the policy, there was a 7.22% decrease (from 249 to 231 incident occurrences) post implementation. However, the one-way ANOVA demonstrated that there was not a statistically significant difference in the overall number of incidents ($p = 0.922$).

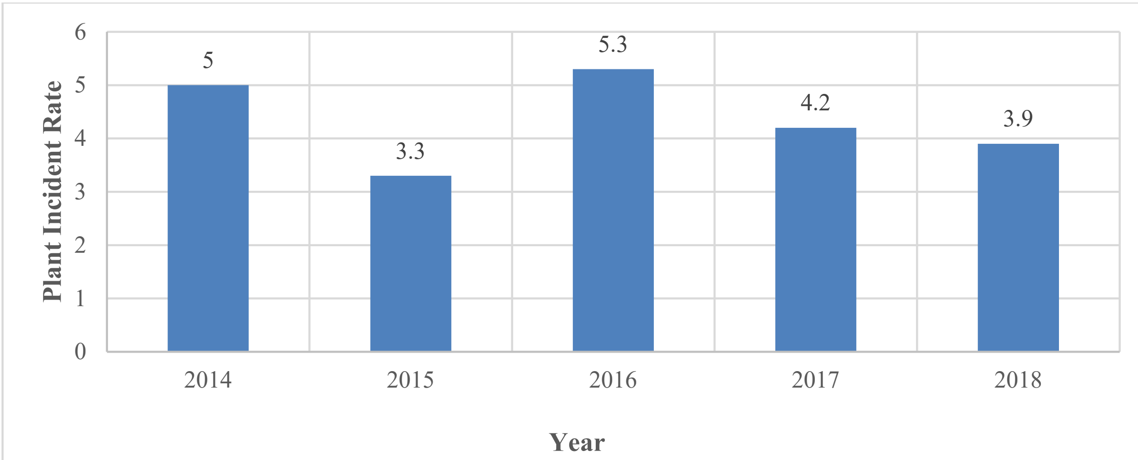

Figure 1. Total Recordable Incident Rate for each year

The number of incidents involving the lower extremities did decrease by 35.93% (from 64 to 41 incident occurrences). However, it appears the focus of injury prevention should not have been put on the lower extremities because only 30.6% of all incidents were to the lower extremities, with the majority of injuries affecting the upper extremities (145 before the policy change and 129 after) The one-way ANOVA performed displays that there is not statistical difference between the number of incident occurrences in regard to the body category with respect to policy status ($p = 0.473$).

The number of incident occurrences during warm months decreased by 25.9% (136 to 108) after the policy implementation while the cold month incident occurrences increased by 8.1% (113 to 123). Despite this, the one-way ANOVA still statistically demonstrates that the number of occurrences is not affected by season with respect to the policy type ($p = 0{,}990$).

The relative risk calculated was based on a treatment group, consisting of incidents occurring before the policy change and a control group consisting of incidents that occurred after the policy change. The result was 0.963 indicating that the policy had little effect on the number of incident occurrences.

4. Discussion

The results of this case study revealed that the average OSHA recordable incident rate and the total number of incident occurrences were not affected by the policy change, supporting what the authors hypothesized. There is evidence found that the departments wearing the white suits have a smaller number of incident occurrences, before and after the policy changes than all the other departments. However, the white suit employees account for a small portion of the work force so it is expected they would have a smaller number of incidents. The larger the population pool the more likely an incident to occur. In addition, the suits were designed to improve quality by reducing contamination – the intentions were not safety based. There is no evidence the suit serves as protective clothing to employees wearing it. The employees wearing said suits could be subjected to the same risk of injury as an employee not wearing the suit – future research would be needed to determine a suitable response.

The blanket policy implemented applied to everyone and it had no correspondence to any specific set of circumstances or any improvement goals. The policy was implemented to protect the lower extremities. However, most incident occurrences before the policy involved the upper extremities which does not serve as evidence in favor of the policy implementation. The intervention design should have focused on the region of the body resulting in the largest number of incident occurrences (in this case upper extremities). Efforts to protect the lower body did not lower the incident rate because it did not address the area with the largest number of occurrences. Even if the most occurrences occurred in the lower extremities, the control may not have worked because it did not involve hazard analysis. Blindly implementing a policy is not effective because the root cause of the problem was not considered and that is an essential step to preventing injuries (Doan, Floyd, & Neal, 2004). In addition, the policy was also generic and did not specify what type of pants needed to be worn (i.e. cut resistant, etc.). Thin pants may not provide much additional protection. Again, the policy could be effective if the proper specifications of attire were investigated and tested for each set of circumstances.

Although there is significant evidence that more incidents occurred in the warmer months this may not allow us to draw conclusions. Typically, people expose more skin in warmer months as a way to keep their body cooler. Therefore, warmer months may be linked to more injuries because people may have been more likely to expose more skin. However, weather patterns vary in Wisconsin and warm months may not actually be warm months. For example, May is a typically warm month, yet snow is not infeasible. In addition, some individuals wear shorts in cooler months regardless of temperatures. The plant is climate controlled in certain areas so that may confound the analysis and cause individuals to dress one way or the other. Individuals may choose to cover their skin just because of their psychosocial view on their own safety in the manufacturing plant. There is no way to directly link attire choices to a season for an entire population as there are many nuisance factors.

Overall, the results have demonstrated that the policy effectiveness is lacking. It is important to think about the biological plausibility as statistical significance does not always align to practical significance. Both pieces of the puzzle need to be considered before making any conclusions. As mentioned, there is no proof that a white suit or pants can protect a person from injuring a lower extremity or that it would reduce the severity of an injury, nor is there a way to prove when employees would have chosen to wear shorts during certain months Without a specific area to focus on and a lack of hazard analyses the team was unable to properly formulate and execute a plan to reduce the plant incident rate and overall number of incident occurrences. Administrative controls need to have specific aims in order to yield favorable results. The relative risk was close to one further supporting the conclusion that the policy has no effect on the total number of incident occurrences. The dress code may have had favorable results if tied to preventing an injury for a specific hazard or circumstance, but future research would dictate that validity.

5. Conclusion

This case study investigated the effectiveness of a specific clothing-related policy in a general manufacturing facility through determining if the policy change had any influence on plant incident rate and the overall number of incidents. The findings indicate that the total plant incident rate was not affected by the policy implementation. The policy change was seen as a tangible way to improve safety, but due to the lack of root cause analysis or any investigation to back that claim it failed to serve its purpose.

While the number of incident occurrences cannot solely be used to make any conclusions because of the disconnect between practical and statistical significance, it is important to point out that any interventions need to be validated before implementation and aligned with the goal of the intervention. From a protective clothing standpoint, the clothing needs to be tested and assigned based on the hazards. Future research could involve identifying various hazards and determining the best way to reduce or eliminate the them from a clothing protectant perspective.

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