Utilizing Hospital Discharge Data (HD) to Compare Fatal and Non-Fatal Work-Related Injuries Among Hispanic Workers in New Jersey

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Background *This study explores the utilization of Hospital Discharge (HD) data to obtain estimates of work-related non-fatal injuries rates in NJ to determine if Hispanics workers have an increased risk of specific work-related injuries. In addition, HD data are used to compare the rate ratios between fatal and non-fatal injuries in this population to demonstrate the effectiveness of using HD as a surveillance tool for monitoring injury trends and performing evaluations.*

Methods *Several types of fatal and non-fatal injuries were modeled using Poisson regression with the following predictor variables: gender, ethnicity, and year. The estimated number of workers by ethnicity employed in NJ each year was obtained from the U.S. Census Bureau, DataFerrett, Current Population Survey, November 2006, a data mining tool which accesses CPS data.*

Results *These analyses, utilizing estimates of working population at-risk, indicate that Hispanic workers have an increased risk of four particular work-related injuries compared with non-Hispanics, and Hispanics were injured at a younger age than non-Hispanics. In addition the rankings of the rate ratios from the comparison between non-fatal and fatal risk estimates were similar; indicating that occupational surveillance of non-fatal injuries is a viable component to be considered.*

Conclusions *HD data are effective for monitoring trends over time across ethnic groups and injury types. Therefore, non-fatal injury surveillance should be considered for targeting specific worker populations for interventions to reduce exposure to workplace hazards, and can be a valuable surveillance tool in efforts to reduce occupational injuries.* Am. J. Ind. Med. 53:146–152, 2010. © 2009 Wiley-Liss, Inc.

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INTRODUCTION

There is evidence that Hispanic workers are at an increased risk for work-related injuries.

According to the Bureau of Labor Statistics (BLS), the fatality rate for Hispanics of 4.9 fatalities per 100,000 workers in 2005 is 22% higher than the rate of fatalities recorded for all US workers [CPWR, 2007]. Further, while fatal work injury rates for non-Hispanic workers in the US are declining, fatal work injury rates for Hispanic workers appear to be increasing [Richardson et al., 2003]. Non-fatal occupational injury rates are also higher

among Hispanic workers [Richardson et al., 2003; Brunette 2004].

There is a need for population-based surveillance for both fatal and non-fatal injuries at the state level to monitor injuries and guide prevention program planning and evaluation [Vyrostek et al., 2004]. Prevention effort decisions should be based on non-fatal injury data as well as fatality data to better understand the scope of the injury problem and its potential effect on society [Vyrostek et al., 2004]. Since the ethnic composition and high-risk industries both vary across states, the utilization of local surveillance data is imperative [Richardson, 2005]. External injury coded (E coded) hospital discharge data systems are an effective means to collect data needed for non-fatal injury surveillance as they are readily available and have been demonstrated to serve as a surveillance tool for serious work-related injuries [Sniezek et al., 1989; Alamgir et al., 2006]. Few studies, however, have utilized Hospital Discharge Data (HD) data as a resource to conduct surveillance of severe non-fatal work-related injuries [Sorock et al., 1993a; Sorock et al., 1993b; Baker et al., 1996; Hagel et al., 2004; Hunt et al., 2005].

The purpose of this study is to utilize HD data to obtain ethnic-specific estimates of work-related non-fatal injury rates among males in New Jersey. Further, in this study we investigate ethnic-specific risk estimates and BLS estimates for both fatal and non-fatal work-related injuries and determine if they are similar. The New Jersey HD data and a work-related fatality surveillance database are used to estimate and compare the risk of work-related fatal and non-fatal injuries in the state between 2001 and 2005 among Hispanic and non-Hispanic males. Rate ratios of six selected injuries comparing Hispanic to non-Hispanic males are obtained for both work-related fatal and non-fatal injuries. We analyze the trend over time for the six work-related fatal and non-fatal injuries investigated in this study, and explore whether the elevated risk among Hispanics observed in the fatality database is similar to that observed in the HD data within each injury type. The distribution of the specific types of injury rates are compared (within ethnic group) between HD (non-fatal) and a State fatality database (fatal) data. The rate ratios between each type of non-fatal and fatal injury are compared to determine if there is a similar magnitude for each type of injury.

Several limitations exist when utilizing HD data for these analyses, including that type of occupation cannot be obtained from these data. Also, self-employed workers, undocumented workers, and those with a lack of awareness of the worker's compensation process, are not captured using this filter [Hunt et al., 2005]. Previous studies have established that the number of work-related injuries from HD will be an underestimate [Sorock et al., 1993a], however, HD data has been shown to be highly sensitive and specific for identifying work-related injuries [Sorock et al., 1993a; Hunt et al., 2005]. Despite the underestimation of rates, utilization of HD data can be instrumental in identify emerging trends in types of injures.

METHODS

Deaths from work-related injuries that occurred in calendar years 2001–2005 were identified through the New Jersey Fatality Assessment Control and Evaluation (FACE) surveillance system, a database of all work-related fatalities in New Jersey compiled by the state health department through a National Institute of Occupational Safety and Health (NIOSH) funded grant. Counts of non-fatal work-related injuries requiring inpatient hospitalizations were obtained from New Jersey inpatient hospital discharge data for years 2001 to 2005. Potential work-related injuries resulting in a hospitalization were identified by culling all visits among males aged 16–89 with one of the six particular International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) E codes under investigation and workers' compensation as the primary expected payer. The E codes investigated in this study are listed in Table I. The type of injuries studied were selected by identifying the six most common types of fatal work-related injuries (excluding homicides/assaults) occurring in New Jersey between 1995 and 2005.

Non-fatal injury data used to conduct this analysis were available for 84 (93% of all) general acute care hospitals. Seven hospitals were removed from analysis because of known errors in the coding of ethnicity (Vali, 2004). All inpatient work-related cases (defined as workers' compensation as the primary payer) among males aged 16–89 were culled from the 2001 to 2005 HD datasets (n = 20,071). From this group we culled cases with one of the injuries under investigation by searching for the relevant E codes (n = 6,313). Individuals who had repeat hospitalizations within the same year were identified by medical record

TABLE I. Occupational Injuries and E Codes Used in HD Dataset Analysis

Struck by falling object	E916, E917.2−E917.4, E917.7−E917.9
Fire/explosion	E923, E890−E899
Electrocution or "accidents caused by electrical current"	E925
Fall-related	E880−E888
Machine-related	E919
Motor vehicle	E810−E825

numbers and only the initial visit was included in the analysis (n = 6,040). Eleven percent of these 6,040 cases had unknown ethnicity and these 664 cases were removed from analysis. A sensitivity analysis was performed in which we assumed these males with missing ethnicity were non-Hispanic, which would bias the rate ratios towards the null, and the results were quantitatively similar. Since the estimated rate ratios changed very slightly and the significance level did not change, this analysis was restricted to those with known ethnicity (n = 5,376).

Rates within ethnicity and year for each type of fatal and non-fatal injury were estimated as the number of events (injury deaths or injury visits) over the estimated number of workers by ethnic group employed in NJ that year (which approximates workers' years at risk). These data were used in Poisson regression to model the rate of each type of fatal and non-fatal work-related injury as an exponential function of ethnicity and year. Hispanic includes Mexican, Puerto Rican, Cuban, Central or South American, Other Spanish, Mexican American, Chicano, and all other Hispanic.

The estimated number of workers by ethnicity employed in NJ each year was obtained from the Current Population Survey (CPS) using DataFerret (U.S. Census Bureau, 2006), a data mining tool which accesses CPS data. The CPS is a monthly national representative household interview survey of 50,000 non-institutional civilians 15 years and older conducted as a joint effort between the BLS and the Census Bureau to obtain employment estimates.

The Wilcoxon–Mann–Whitney rank sum test was used to compare median age between Hispanic and non-Hispanic males within each type of fatal and non-fatal injury. All analysis were carried out using SAS [SAS, 2007].

RESULTS

The median age among Hispanic males was statistically significantly lower than non-Hispanic males for non-fatal work-related injuries resulting from falls ($P < 0.01$), machine-related ($P < 0.01$), motor vehicle incidents ($P < 0.01$), and struck by objects ($P < 0.01$). Hispanic males who died as a result of a work-related fall ($P = 0.01$), machine-related ($P < 0.01$), or motor vehicle ($P < 0.01$) injury were younger than non-Hispanic males involved in the same type of work-related fatal incident (see Table II).

The distribution of the number of fatal and non-fatal work-related injuries among males are shown within each ethnic group over years 2001–2005 (Table II). Work-related falls was the most common type of non-fatal work-related injuries requiring hospitalization among both Hispanics (41%) and non-Hispanics (48%). However, the ranking differed for the secondary cause of non-fatal injury; machine-related injuries were the second most common types of injuries among Hispanics (27%), while motor vehicle incidents were the second most common type among non-Hispanics (22%).

The leading cause of fatal injury differs between the two ethnic groups. Among non-Hispanic males, the majority of the work-related fatalities were motor vehicle incidents (48%) followed by falls (22%). Conversely, fatal fall related incidents were the most common type of work-related

TABLE II. Median Age by Ethnicity and Type of Fatal and Non-Fatal Injury Among Males 2001–2005

| | n | % | Hispanic | | P-value | n | % | Non-Hispanic | |
			Median age	Min, max				Median age	Min, max
Fatal injuries									
Electrocution	4	4	34	24, 46	0.48	16	5	43	21, 69
Fall-related	36	32	37	20, 66	0.01	70	22	49	18, 85
Machine-related	21	19	37	20, 61	<0.01	40	13	48	19, 82
MV	28	25	33	18, 56	<0.01	153	48	46	18, 88
Struck by object	14	13	39	23, 53	0.31	24	8	43	18, 63
Fire/explosion	8	7	38	19, 66	0.98	14	4	39	27, 59
	111					317			
Non-fatal injuries from HD									
Electrocution[a]	17	1	33	19, 56	0.11	107	3	40	19, 64
Fall-related	522	41	37	17, 84	<0.01	1,961	48	45	16, 88
Machine-related	344	27	34	16, 78	<0.01	551	14	41	17, 74
MV	198	15	40	16, 87	<0.01	906	22	43	16, 89
Struck by object	181	14	35	18, 64	<0.01	469	12	40	16, 77
Fire/explosion	24	2	35	20, 51	0.55	96	2	39	18, 63
	1,286					4,090			

[a]Accidents caused by electrical currents.

fatality among Hispanic males (32%) with motor vehicle incidents the second leading cause in this group (25%).

Rate ratios comparing Hispanics to non-Hispanic were obtained for fatal and non-fatal injuries resulting from electrical shock incidents, falls, machine-related incidents, struck by object incidents, fire/explosions, and motor vehicle crashes while controlling for year (see Table III).

Hispanic males have a statistically significant higher rate of hospitalization for injuries from work-related falls, motor vehicle accidents, machine-related incidents, and struck by objects than non-Hispanic males (Table III). This is similar to fatal injuries; Hispanic males have a statistically significant higher fatality rate of work-related falls, machine-related incidents, struck by objects, as well as fire/explosion (Table III). There is no statistically significant difference in the rate of hospitalization for work-related injuries for accidents involving electric shock, motor vehicle, or fire/explosion between Hispanic and non-Hispanic males. There is no statistically significant difference in work-related fatality rates of electrocution or motor vehicles between Hispanic and non-Hispanic males (Table III).

There was no effect of year on any of the work-related fatality rates (Table III). There was a statistically significant 8% decrease in the rate of work-related machine-related injuries requiring hospitalization each year between 2001 and 2005 (RR 0.92 with 95% CI (0.88, 0.96). Work-related injuries involving struck by objects (RR 0.93 with 95% CI (0.89, 0.98)) decreased 7% each year between 2001 and 2005. There was no change over time with the hospitalization rate of injuries involving electrical currents or fires/explosions (Table III).

DISCUSSION

Hospital admission analyses indicate an increased risk of work-related injuries requiring hospitalization among Hispanic males for work-related falls, motor vehicle incidents, struck by objects, and machine-related incidents compared to the US working population. This observation is consistent with previous findings exploring injury rates among Hispanics within states [Sorock et al., 1993b; Baker et al., 1996; Anderson et al., 2000; Hunt et al., 2005; Friedman and Forst, 2007]. A previous study investigating a wide range of occupational injuries identified by nature of injury in Massachusetts HD data found Hispanics to have an increased risk of injury [Hunt et al., 2005]. Work-related finger amputations requiring hospitalization in New Jersey were also found to be higher among Hispanic males than white males [Sorock et al., 1993b]. Hispanic workers were found to be two times more likely to suffer traumatic occupational injuries than non-Hispanic workers in an Illinois trauma registry [Friedman and Forst, 2007]. A study in a Washington, D.C. emergency department (ED) found a larger proportion of Hispanic males experienced injuries requiring an ED visit for work-related falls, struck by a falling object but a lesser risk of being injured from electrical exposures compared to white males, which is also confirmed by our findings [Anderson et al., 2000]. Further, injured Hispanic workers visiting an ED were more likely to be hospitalized compared to non-Hispanic males requiring an ED visit for a work-related injury [Anderson et al., 2000]. Interestingly, the magnitude of the rate ratios comparing Hispanic to non-Hispanic males was greater for fatal injuries than hospitalizations for falls, fire/explosion, and struck by object. This may suggest that Hispanic males have a greater risk of more serious injuries, resulting in death, similar to a previous study that indicated Hispanics are more likely to be hospitalized for an injury requiring an ED visit [Anderson et al., 2000]. However, the reporting of non-fatal injuries may be biased, as Hispanic workers may be more or less likely to report work as the place of injury or may be more or less likely to seek hospital care, for less severe non-fatal injuries.

TABLE III. Rate Ratios and 95% CI Work-Related Fatal and Non-Fatal Injury for Hispanic to Non-Hispanic Males Across Years 2001−2005

Type of injury	Non-fatal		Fatal	
	RR	95% CI	RR	95% CI
Electrocution				
Hispanic	0.98	0.59, 1.64	1.65	0.55, 4.94
Non-Hispanic	1.0		1.0	
Year[a]	1.01	0.89, 1.13	0.8	0.56, 1.06
Fall-related				
Hispanic	1.65	1.5, 1.82	3.08	2.05, 4.63
Non-Hispanic	1.0		1.0	
Year[a]	0.98	0.96, 1	0.99	0.84, 1.09
Fire/explosion				
Hispanic	1.58	1.01, 2.48	3.72	1.56, 8.9
Non-Hispanic	1.0		1.0	
Year[a]	0.91	0.81, 1.03	0.8	0.6, 1.09
Machine-related				
Hispanic	3.94	3.44, 4.51	3.24	1.91, 5.51
Non-Hispanic	1.0		1.0	
Year[a]	0.92	0.88, 0.96	1.0	0.84, 1.2
MV				
Hispanic	1.36	1.17, 1.59	1.12	0.75, 1.68
Non-Hispanic	1.0		1.0	
Year[a]	0.96	0.93, 1.0	1.0	0.9, 1.11
Struck by object				
Hispanic	2.43	2.04, 2.88	3.6	1.86, 6.98
Non-Hispanic	1.0		1.0	
Year[a]	0.93	0.89, 0.98	1.02	0.8, 1.25

[a]The rate ratio for year represents the increase of the injury rate comparing each year to the previous year. The year-to-year injury rate was found to be constant over time through regression analysis.

In this study, the risk of a work-related fatality from falls, fire/explosions, machine-related, or struck by object were also statistically significantly elevated among Hispanic compared to non-Hispanic males. These findings are consistent with previous studies which demonstrated an increased risk of work-related fatal injury among Hispanic males [Richardson, 2005]. Further, we show a correspondence between ethnic-specific ranking of fatal and non-fatal types of work-related injuries in New Jersey. We also found similarities in the mean age of fatal and non-fatal work-related injuries within ethnicity and type of injury. This further supports the correspondence between injuries and fatalities. The evidence that the frequency of fatalities mirror the non-fatal injuries within ethnicity has several implications for work-related injury prevention and surveillance efforts. Specifically, monitoring HD data for increases or decreases in hospitalizations for particular injuries can serve as a means to evaluate the impact of interventions focused on the prevention of specific injuries. The timeliness of HD data allows for trends in hospitalization rates to be monitored for decreases by targeted injury mechanisms following occupational health surveillance activities, including educational outreach and industrial hygiene interventions to specific populations.

Non-fatal injury surveillance should be considered for targeting specific worker populations for interventions to reduce exposure to workplace hazards, and can therefore be a valuable surveillance tool in efforts to reduce occupational injuries. The occupational health field has depended on the BLS Survey for directing prevention efforts and targeting interventions. However, as noted [Rosenman et al., 2006; Boden and Ozonoff, 2008], these data may have deficiencies; specifically undercounting workplace injuries. The traditional approach of work-related injury prevention primarily focused on work-related fatality surveillance (e.g., the BLS estimates), however our results indicate the inclusion of non-fatal injuries may enhance prevention efforts. This study suggests monitoring injuries through HD data may enhance our ability to prioritize those most at need for a targeted intervention. Analysis of surveillance data and characterizing populations that are at greatest risk and who can most benefit from an intervention, enables the dissemination of educational materials to be targeted to the groups who have the highest risk of traumatic and fatal injuries. Additionally, the use of HD and ED datasets yields more timely data, which is an advantage over the BLS estimates.

In this study, motor vehicle injuries were the leading cause of fatal work-related injuries and falls were the leading cause of non-fatal work-related injuries among non-Hispanic males, which is consistent with findings from CDC's National Vital Statistics System (NVSS) and National Electronic Injury Surveillance System All Injury Program (NEISS-AIP) [Vyrostek et al., 2004]. Contrary to this, in our study, the leading cause of fatal injuries among Hispanic males was falls. Additionally, Hispanic males were younger than non-Hispanic males for most of the fatal and non-fatal injuries investigated. The age distribution of the NJ working population is similar to the age distribution of fatal and non-fatal injuries of Hispanic and non-Hispanic male workers. Specifically, the mean age of Hispanic male workers (aged 16–90) in NJ is 36.5, while non-Hispanic male workers are 42. The reasons for the younger working population are likely due a combination of factors including a large population growth among Latinos or persons of Hispanic origin in NJ, immigration, and high fertility fecundity rates among Hispanics (Wu, 2006). On average, non-union and production (blue collar) workers are younger than union/professional workers, and in addition, Hispanic construction workers in the US are, on average, 6 years younger than non-Hispanic workers [CPWR, 2007].

The finding of a statistically significant decrease in the rate of work-related injuries requiring hospitalizations resulting from machine-related, struck by object, and a marginally statistically significant decrease in work-related falls, and motor vehicle accidents corresponds with a national surveillance studies showing a decline in occupational injuries in the past 2 decades [CDC, 2007; USDOL, 2007]. However, our results are not consistent with an analysis of the Illinois Trauma registry which did not find a decline in occupational injuries between 1995 and 2003 [Friedman and Forst, 2007].

The increased risk among Hispanics may at least in part be due to the fact that Hispanic workers are disproportionately represented in higher risk occupations [Anderson et al., 2000; Richardson et al., 2003; Brunette, 2004]. Rates may be higher among Hispanic males because of a higher proportion working in hazardous industries [Gaddie, 2007]. Future analyses should explore industry and occupation specific risk estimates by gender and ethnicity, however precise highly stratified (ethnic-, gender-, industry-, and occupation-specific) working population estimates are not currently available. Although it is likely that rates might be higher among Hispanic males because of a higher proportion working in hazardous industries, other factors may contribute to the increased risk of work-related injury among Hispanics. Factors may include language, lack of adequate training, within job race-based task assignments, lack of awareness of safety regulations, literacy and cultural barriers, and should be investigated in future research to identify target areas for intervention [Cierpich et al., 2008].

There are several limitations related to the utilization of HD data for work-related injury surveillance. One possible limitation is underreporting due to the reliance of worker's compensation as primary payer to identify work-related injuries. Self-employed and undocumented workers, and those with a lack of awareness of the worker's compensation process are not captured using this filter [Hunt et al., 2005]. Although studies have found HD data to be highly sensitive

and specific for identifying work-related injuries [Sorock et al., 1993a; Hunt et al., 2005] it has been established that the number from HD will be an underestimate [Sorock et al., 1993a].

Another limitation identified is that non-fatal data are representative only of injuries in which the patient was hospitalized, and do not include data related to injured persons treated in an ED or other outpatient health-care facility, nor those not receiving medical care [Vyrostek et al., 2004]. Additionally, there are an absence of data on New Jersey residents who were injured on the job in New Jersey but treated at a bordering states' hospital.

Although administrative data are useful to fill the void of non-fatal injury surveillance, a limitation of using administrative data is the reliance on the accuracy of codes not collected for research purposes [Alamgir et al., 2006]. For instance, the reporting of patient race and ethnicity in HD data is often not adequate [Vali, 2004]. However, there has been an ongoing initiative since 1996 to ensure that race and ethnicity data reported by New Jersey hospitals are accurate. The Health Research and Educational Trust of New Jersey (HRET), a non-profit affiliate of New Jersey Hospital Association, conducts ongoing educational sessions to improve the quality of race and ethnicity information collection, coding and reporting, and to ensure that coders are following the unified guidelines from the Office of Management and Budget on patient self identification of race and ethnicity. Specifically, HRET conducts ongoing outreach to coders, including development of a script for staff to use when discussing race/ethnicity with patients, a notice for patients on the reasons for collecting data, assurance of confidentiality of their response, and a laminated card with the race and ethnicity options which patients could choose from for patients to self identify their race and ethnicity [Vali, 2004].

Another limitation of these administrative data is that E code reporting may not be complete, thus cases who are hospitalized due to an injury might not have an E code recorded. However, the state of NJ issued guidelines for mandatory E code reporting in 1994 and there is a separate E code field in NJ UB data [Abellera et al., 2005]. In an evaluation of E codes in NJ HD conducted in 1997, 95% of injury discharges were E coded [Abellera et al., 2005].

There are also limitations with the denominator data used to calculate these rates. The denominator does not include illegal immigrants or undocumented workers, and thus underestimates the population at risk. However, since self employed or migrant workers who are not aware of nor eligible for workers' compensation would not have workers' compensation listed as primary payer, these work-related injuries identified in HD are missing in the numerator as well. Consequently, there may be selection bias because of eligibility of worker's compensation and an under-ascertainment of work-related injuries in these populations not eligible or unaware of worker's compensation, but this bias is in both the numerator and denominator of injury rates. However, since work-related fatalities would be captured regardless of documentation or migrant workers, the work-related fatality rates may be a slight overestimate due to the denominator.

In 2003, BLS implemented changes in collection of CPS data including the protocol of how individuals were asked about race and ethnicity, shifts in the census-based population, as well as modifications of weighting procedures [Bowler et al., 2003]. In order to test for a population effect of the increased number of Hispanics due to the survey changes confounding our results, we tested for effect modification of year on each of the Hispanic to non-Hispanic fatal and non-fatal injury rates. We stratified on year and compared rate ratios of Hispanic to non-Hispanic and they were consistent across years. Therefore there was no confounding by this change in how ethnicity was collected by CPS.

Although mean rates estimated by a model may be affected by undercounting of work-related injuries and undercounting of numbers of workers employed, the comparison of covariates (such as ethnicity or year) is not affected by undercounting. In a study of data limitations on an analyses of trends on work-related fatality analysis using simulations, a previous study found estimates of trends are accurate under varying conditions in a simulation they carried out as long as finely stratified worker population estimates are not used [Bena et al., 2004]. Finely stratified analyses, such as stratifying on occupation or industry, would have larger biases than when larger populations, such as categorized into Hispanic or non-Hispanic [Bena et al., 2004].

Although highly stratified estimates of CPS may be imprecise, it is thought CPS is an unbiased and valuable source of information [Richardson et al., 2004]. If numerator biases are constant (i.e., consistently undercounted in different subgroups), then relative risks comparing covariates or assessment of trends over time would not be affected. Another advantage of using CPS data as denominator data is that seasonal variations in employment rates are taken into account because annual estimates are derived by aggregating results of the monthly survey.

Future analyses of gender-specific ethnic differences of specific types of injuries using detailed E codes should be carried out (e.g., distinguishing between falls from steps vs. falls from ladders). In order to reduce occupational injuries, interventions should target workers at highest risk and reduce exposure to those workplace hazards. Intervention methods should be tailored to suit the needs of the specific at-risk worker populations. Conducting surveillance of work-related injuries using HD data can enhance work-related fatality surveillance by assisting in the identification of groups most at risk for work-related injuries. Analyses of these data enable us to characterize populations that are at

greatest risk of a work-related injury and who can most benefit from an intervention or dissemination of educational materials, and tracking injury rates can help evaluate these interventions.

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