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Measuring Healthcare Workers' Workplace Violence Exposure Over Time Using Workers' Compensation Claims

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ABSTRACT

Background: Workplace violence towards healthcare workers impacts workforce stability and patient care delivery. California passed a workplace violence prevention standard, phased in during 2017-2018, requiring enhanced tracking and training in healthcare workplaces. Workers' compensation claims provide a tool to track frequency of violence over time.

Methods: This descriptive study synthesizes data from the California Workers' Compensation Information System (WCIS) covering all healthcare workplaces in the state. Claims included were filed from 2013 to 2021. We tabulated the annual rate of workplace violence-related claims, types of workplaces with high rates of claims, and types of injuries caused by violence.

Results: We identified 46,762 violence-related workers' compensation claims over the study period from a total of 418,278 total claims (11%). The highest rate of violence-related claims was in 2019 (5.6 claims per 1000 healthcare workers). Residential care facilities for children reported 31% of their total claims as violence-related, and psychiatric and substance-use hospitals reported 35% of their total claims as violence-related. Most healthcare industry claims were from individuals working in hospitals, and employees in these workplaces reported between 11% and 13% of total claims as violence-related.

Conclusions: Workers' compensation claims provide an important description of workplace violence exposure among healthcare workers, and the relative stability of measurement makes it a useful way to track the impact of mitigation strategies over time. It would be valuable for workers' compensation claims managers to capture an assessment of whether an incident involved violence to facilitate appropriate connection to needed resources, including psychological support, for an injured worker.

1 | Introduction

Workplace violence towards healthcare workers is increasingly recognized as a threat to workforce stability and capacity to meet patient care needs [1–3]. The healthcare workforce has long been recognized as one of the occupational groups most at risk for violence exposure on the job [4, 5]. The culture of healthcare has

contributed to the difficulty in implementing effective mitigation strategies, as workers, whether implicitly or explicitly [6], have been asked to endure violence in the name of providing patient care to all who seek it [7, 8]. The challenges in effectively preventing violence are also linked to difficulty in tracking it as the problem is known to be under-reported through official channels [9, 10].

Institution at which the work was performed: University of Wisconsin-Madison.

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As workforce shortages have exerted pressure on healthcare systems and increased public discussion of occupational hazards, legislators have made efforts to protect healthcare workers through violence prevention requirements [11]. Some U.S. states have pursued enhanced criminal penalties for those who assault healthcare workers and others have proposed stronger requirements for employers to make changes to the workplace and training practices. Twenty-seven U.S. states considered 100 bills aimed at workplace violence prevention during 2023, and 11 states enacted new laws [12]. U.S. federal legislation has recently been proposed capturing both approaches, with bipartisan support bringing greater attention to increasing demand for action [13, 14]. Ethical and practical considerations remain for policymakers and other entities, as there are minimal data demonstrating that legislative changes affect workers' exposure to violence, and advocates have pushed back against drawing patients experiencing medical or mental health crises into the criminal justice system [15].

1.1 | California Legislation

California's approach emphasizes employer responsibility, requiring healthcare employers to make changes to work design and practice to comply with new California Occupational Safety and Health Administration (CalOSHA) standards [16]. In addition, hospitals are required to share details of incidents after they occur through a centralized reporting system [17, 18]. With strong support from several healthcare workers' unions in the state, SB 1299 was passed in 2014 and resulted in an occupational health standard (Title 8, Section 3342) which went into effect in 2017–2018. The legislation applies to all California healthcare providers and facilities, defined to include skilled nursing facilities and all types of hospitals, home health care and hospice providers, emergency medical services and medical transport services, drug treatment programs, and outpatient medical services provided to the incarcerated. New requirements include establishing a workplace violence prevention plan, training the workforce in definitions of workplace violence and prevention, and recording a description of violent incidents towards staff [19].

There are few data sources with the capacity to track long-term trends in workplace violence exposure, as reporting practices and definitions have changed over time. Workers' compensation claims provide one approach for measuring longitudinal change; physicians and other providers file claims on behalf of workers who take time away from work or seek compensation. Such data are thought to undercount the true incidence of work-related injuries and illnesses [9, 20], but can offer a measure of change over time [21]. As new violence prevention legislation is considered at the state and federal levels, it is important to understand what approaches are most effective. The purpose of this study is to describe how California healthcare workers' exposure to workplace violence has changed over time, including during the years surrounding the implementation of the state's new violence prevention standard. A secondary aim is to describe how violence-related workers' compensation claims vary by type of workplace within the healthcare sector and by type of injury to the worker.

2 | Methods

To describe California healthcare workers' violence-related injuries, we used the state's Workers' Compensation Information System (WCIS) data and included claims filed from 2013 to 2021. We calculated annual frequencies of claims, then derived rates by incorporating statewide employment data from the Employment Development Department. We also utilized the WCIS data to tabulate which types of workplaces were associated with the greatest frequencies of violence-related claims and what types of injuries were most commonly caused by violence on the job.

2.1 | Ethics Statement

This study was approved by the University of Wisconsin-Madison Institutional Review Board (Project ID: 2023–1023), and the California Committee for the Protection of Human Subjects (the entity that oversees projects utilizing California's state-owned data; Project Number 2021–214). This study involved analysis of previously collected, de-identified, claims data and so informed consent was not required.

2.2 | Data and Study Population

California's WCIS is a claims database that includes two types of reports: First Report of Injury (FROI) and Subsequent Report(s) of Injury (SROI). These reports are filed by physicians and other providers who assess injured workers and are the first step required for any employee who seeks to obtain treatment, time off, or wage recovery for an injury sustained at work. All California employers are required to carry workers' compensation insurance coverage and provide benefits should a worker be injured on the job [22]. Other legislative efforts aimed at protecting healthcare workers have also been evaluated using FROI data [23], as has the impact of workplace violence on specific injuries and health outcomes such as traumatic brain injury [24].

2.2.1 | Healthcare Workers Identification

We identified healthcare workers through a combination of fields included in the FROI. The standardized codes used to classify workers by type of work setting include those provided by the Workers Compensation Insurance Rating Bureau of California [25] (Classification Codes) and the industry description codes provided by the North American Industry Classification System [26]. Because previous research has described how solely using these codes for research has the potential to yield inaccurate results because of missingness and misclassification [23], we also utilized the available free text fields which included a job description and the name of the employer. We required that one or more of the available fields for identifying workers in the industry be provided. The full strategy for using these fields in combination to best capture the relevant workforce is described in Supporting Information S1. Denominators used to calculate rates of workplace violence-related claims are from California Employment Development Department data [27]. Annual estimates of workers in each industry reflect the estimated total number of exposed workers.

2.2.2 | Claims Identification

Workplace violence has multiple definitions, incorporating a range of experiences from verbal threats, harassment, to physical assault [28, 29]. Workplace violence is classified into one of four types: Type 1: violence committed by an individual with no legitimate business at the workplace (e.g., during a robbery or other criminal act), Type 2: committed by customers, clients or patients (e.g., while receiving healthcare services), Type 3: committed by a co-worker, supervisor, or vendor, or Type 4: committed by an individual with a personal connection to the employee but no other relationship to the workplace [16]. We used California's workplace violence prevention standard to inform our definition: "The threat or use of physical force against an employee that results in, or has a high likelihood of resulting in, injury, psychological trauma, or stress, regardless of whether the employee sustains an injury." [19] California's language includes violence caused by any assailant, so claims included in this analysis could be related to any of the four types of violence.

Because workers' compensation claims entail the worker's sustaining harm that leads to filing a claim, identified claims were unlikely to be solely due to verbal threats, however, we used the California standard's language to define the phenomenon broadly and capture psychological harms as well as physical ones. To identify violence-related claims, we began by identifying 10 potential injury description codes that could be used to describe an incident involving violence, including cuts, falls, strains, or general injuries. We also included codes that described the incident more broadly, in terms such as "fellow worker, patient, or other person" and "person in act of a crime." These standardized codes are defined by the Workers' Compensation Insurance Organization and provide a brief description of an injury or illness [30]. Because there is no category for workplace violence, we used a combination of the codes provided along with analysis of the free text field "injury description" to facilitate appropriate classification. We then created combinations of codes and free-text injury descriptions to arrive at our final identifiers of violence-related claims. This procedure is described in Supporting Information S2.

For the identification of healthcare workers and violence-related claims, we manually checked 10% of the included claims to

assess for accuracy of the coding strategy. This led to increased precision of our free text search strategy both for cause of injury (e.g., exclusion of "insect" or "animal" cases from the category of "bites") and for workplace description or employer name (e.g., exclusion of "day care" to capture workplaces that provided healthcare services instead of childcare). After additional terms were excluded or included, an additional 10% of claims were verified until there were no further changes needed.

2.2.3 | Outcome

The primary outcome for this descriptive study is the annual rate of workplace violence-related claims per 1000 workers. Additional outcomes include frequencies of the type of injury sustained and the class or industry code associated with each claimant's employer.

3 | Results

The totals of healthcare workers' annual workers' compensation claims by year are reported in Table 1. The estimated numbers of healthcare workers currently employed in the state according to California Employment Development Department data are presented in the total workers column. Healthcare workers filed 418,278 workers' compensation claims during the study period, with 46,762 (11%) attributable to workplace violence. Healthcare workers filed their highest rate of violence-related claims (5.6 claims per 1000 workers) and overall claims (44.5 per 1000 workers) in 2019.

Table 2 provides further details about the type of workplace where a healthcare worker was employed when they filed a claim. Classifications of workplaces are presented as the class code or industry code for each claim (if the claim was coded using one of those fields). A claim could be included in both the class code and industry code sections of the table; because the definitions of these workplaces vary by classification system, both are provided for completeness. The percentage of the total claims and total violence-related claims are summarized for each type of code. Psychiatric hospitals (35%) and residential care settings (22%–31%) reported a greater proportion of their total claims from violence than other types of healthcare

TABLE 1 | California healthcare workers' claims due to violence and for all other causes by year (2013–2021).

Year	California healthcare worker population ^a	Healthcare workers' total claims (rate per 1000 workers)	Healthcare workers' violence-related claims (rate per 1000 workers)
Total		418,278	46,762
2013	1,028,600	43,188 (42.0)	4108 (4.0)
2014	1,038,180	43,572 (42.0)	4326 (4.2)
2015	1,051,940	45,501 (43.3)	4449 (4.2)
2016	1,070,900	47,148 (44.0)	4773 (4.5)
2017	1,124,370	49,057 (43.6)	5364 (4.8)
2018	1,161,430	50,980 (43.9)	6267 (5.4)
2019	1,160,100	51,585 (44.5)	6439 (5.6)
2020	1,194,870	42,636 (35.7)	5358 (4.5)
2021	1,176,350	44,611 (37.9)	5678 (4.8)

^aCalifornia Employment Development Department data with home health aides subtracted based on major change in definition starting with 2020 data. See Supporting Information S1 for further information.

TABLE 2 | Number of overall and violence-related workers' compensation claims by type of workplace or industry for selected categories including California healthcare workers (2013–2021).

Class code or industry code* associated with claim	All workers' compensation claims (N, % of all claims)	Violence-related claims (N, % of class's or industry's total claims)
Class code	366,405 included class codes	42,419 (12%)
Hospitals	79,783 (22%)	10,562 (13%)
Skilled Nursing Facilities	30,267 (8%)	5531 (18%)
Residential care facilities for the elderly – NOC	17,985 (5%)	2871 (16%)
Nursing care – in private residences	16,213 (4%)	1919 (12%)
Residential care facilities for children	5478 (1%)	1700 (31%)
Residential care facilities for the developmentally disabled	5369 (1%)	1459 (27%)
Social rehabilitation facilities for adults/substance use disorder recovery homes	5010 (1%)	861 (17%)
Ambulance services	4966 (1%)	580 (12%)
Industry code	413,283 included industry codes	46,316 (11%)
General medical and surgical hospitals	77,010 (19%)	8341 (11%)
Nursing care facilities (Skilled Nursing Facilities)	23,623 (1%)	3915 (17%)
Psychiatric and substance abuse hospitals	6120 (6%)	2141 (35%)
Residential intellectual and developmental disability, mental health, and substance abuse facilities	6852 (2%)	1487 (22%)

settings. General medical hospitals' and skilled nursing facilities' workers reported between 11% and 18% of their claims due to violence. Figure 1 provides a depiction of the quarterly number of violence-related claims over the study period by industry code, with each type of workplace shown in a different line on the graph.

All claims included in our analysis were classified using a "cause of injury code." Table 3 provides a summary of the types of injuries that healthcare workers sustained during the study period which were classified with one of the selected injury codes. Approximately 13% of healthcare workers' claims were coded as "caused by a fellow worker, patient, or other person," and over half of these (51%) were determined to be violence-related in our analysis. Notably, this code does not distinguish between the types of assailants, so these claims could be due to any of the four types of workplace violence described above. By our definition of workplace violence, we determined that all claims coded with the designation "person in act of a crime" constituted workplace violence, contributing to 2% of the overall workers' compensation claims and approximately 15% of the violence-related claims filed during the study period.

4 | Discussion

4.1 | Tracking Workplace Violence Over Time

This study presents findings from analyses of California's workers' compensation claims data to describe healthcare workers' violence-related claims from 2013 to 2021. One important contribution these findings offer is provision of data on what workers' exposure to violence on the job has been in the period before and after implementation of the state's workplace violence prevention standard. While the period

covering the statewide shutdown associated with COVID-19 during 2020 and early 2021 shows decreased violence-related workers' compensation claims from workers in general hospitals and skilled nursing facilities, others in psychiatric treatment facilities and residential treatment environments saw relatively stable claims during that time. This is generally similar to other analysis describing workplace violence exposure among California healthcare workers during the pandemic [31].

California's workplace violence prevention standard was implemented in stages, an approach designed to allow healthcare organizations time to learn about new requirements and develop solutions to adjust their existing practice as needed. During 2017, healthcare employers were required to meet minimum standards for internal recordkeeping practices related to workplace violence, and hospitals were required to begin using a centralized reporting system for incidents of violence administered by CalOSHA. During 2018, the remaining requirements from the standard were enacted, which included development and implementation of a violence prevention plan for each workplace and training for staff members [19]. All healthcare facilities in the state, including inpatient, outpatient, and home health settings, were required to comply with the new standard.

While the complete standard took effect in 2018, it is likely that changes in incidence of violence would not appear immediately, which is why 2018–2019 is conceptualized as an appropriate implementation period [32]. However, because the implementation period 2018–2019 was immediately followed by the COVID-19 shutdown, it is difficult to offer conclusive analysis of trends in the rate of claims over this period or to provide a meaningful comparison group as the state's workforce and working conditions underwent significant changes across all sectors serving the public. As additional years pass following California's implementation of the standard, it will be important to continue tracking workplace

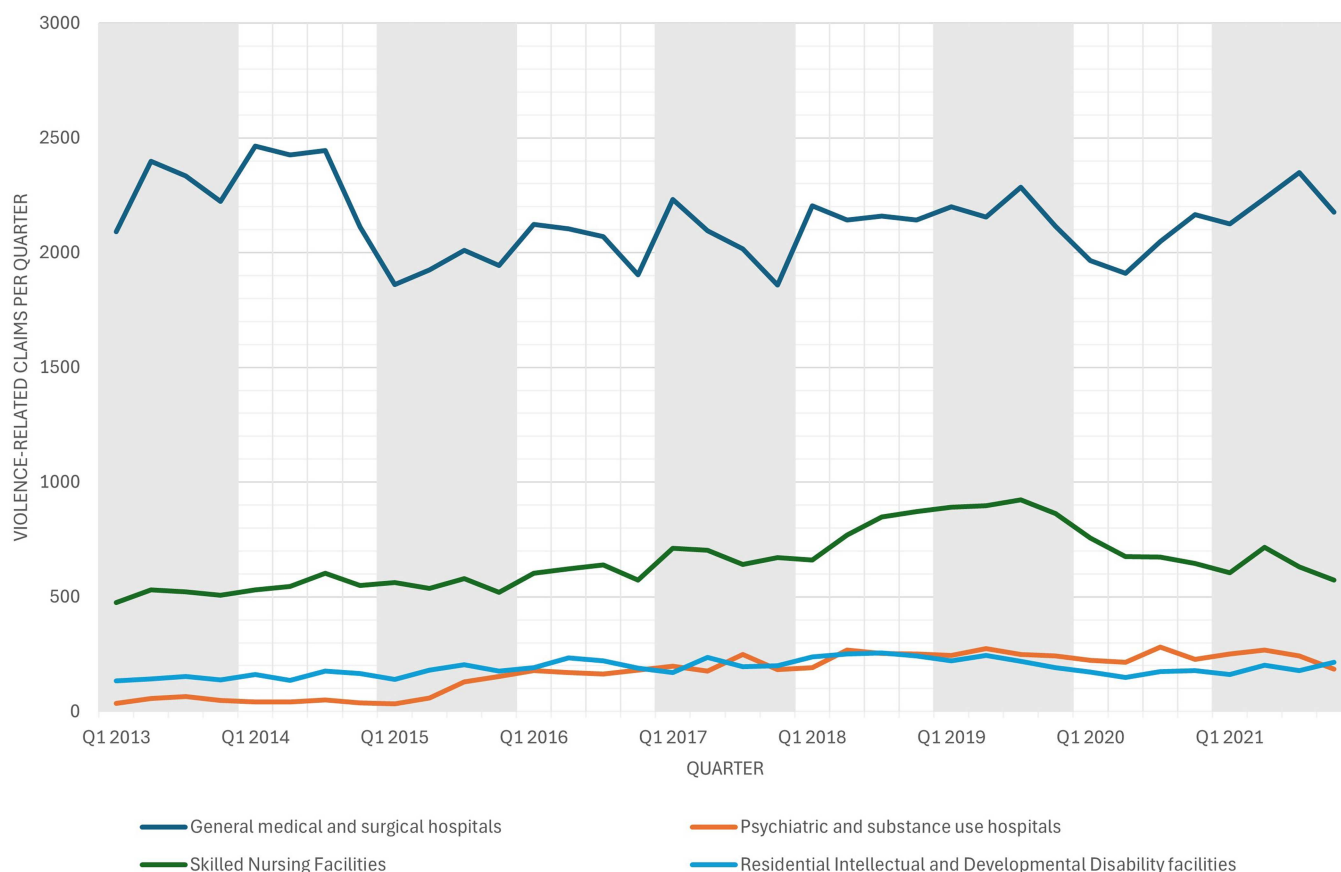


FIGURE 1 | Violence-related workers' compensation claims from California healthcare workers for selected types of workplaces or industries by quarter (2013–2021). [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1002/ajim.70079)]

TABLE 3 | California healthcare workers' claims by type of injury, selected injury codes (2013–2021).

Code	Total in each category for healthcare workers (N, %)	Violence-related (after free-text processing) (N, % of type of injury caused by violence)
Total of included codes	418,278 (100%)	44,838 (11%)
19: Cut, puncture, scrape	54,142 (13%)	1924 (4%)
31: Fall, slip, or trip	47,135 (11%)	305 (1%)
60: Strain or injury by, NOC	73,041 (17%)	1664 (2%)
70: Striking against or stepping on	5920 (1%)	229 (4%)
74: Fellow worker, patient or other person	55,909 (13%)	28,564 (51%)
81: Struck or injured	30,766 (7%)	4593 (15%)
89: Person in act of crime	6578 (2%)	6578 (100%)
90: Other than physical cause of injury	16,784 (4%)	258 (2%)
98: Cumulative noc	52,638 (13%)	108 (0%)
99: Other - miscellaneous	75,365 (18%)	2539 (3%)

violence through workers' compensation and other mechanisms to determine whether requirements included in the standard are making a difference in safety.

The results of this study should be situated among the other sources of epidemiological data describing workplace violence exposure among healthcare workers. The Bureau of Labor Statistics (BLS) is an important source of occupational health

and safety data, and classifies workplace violence (nonfatal) as "intentional injuries by another person that required at least a day away from work." [33] BLS analysis of 2020 national data found 18,690 total workplace violence-related injuries, with 8590 (23%) occurring in the healthcare sector [33]. Our analysis found 5059 violence-related claims from healthcare workers during 2020 in California alone.

One contribution to this discrepancy is that our analysis did not require a day away from work. At the same time, filing a workers' compensation claim is indicative of a serious incident, so it is notable that data from California healthcare workers alone approximate 60% of the total reported by BLS. In addition, the California standard's language does not require that the incident is "intentional," and so our methods did not capture solely those types of claims. In Table 2, we show that 64% of total violence-related claims were coded as "fellow worker, patient or other person" or and 15% were coded as "person in act of a crime," language which is likely to most closely approximate the BLS approach. This difference in definitions likely contributes to the higher numbers in our study.

The question of whether an incident is an intentional act of violence is consequential for policy efforts aimed at keeping workers safe on the job. While many agree that overtly criminal behavior should be addressed using enhanced law enforcement and security presence, it is often challenging to address the Type 2 violence healthcare workers face from patients and their family members. These individuals are engaged in a legitimate, and often essential, relationship with healthcare staff and may be experiencing symptoms of mental illness, distress, or confusion that do not meet criteria for criminality, but nonetheless can cause harm to workers both physically and psychologically. It will be important for advocates and policy makers to consider both types of violence in safety efforts.

Other recent analysis utilizing the BLS Survey of Occupational Injuries and Illnesses (SOII) found that California healthcare workers reported increased rates of workplace violence-related injuries during 2018–2019, after the new legislation went into effect [32]. Increased emphasis on reporting required by workplace violence prevention programs may have contributed to the apparent increase, an environmental shift which can pose a challenge to any longitudinal analysis of workplace violence incidence. In addition, while an important source of national data, the SOII relies on voluntary employer disclosure of adverse events, an issue which presents challenges to data validity [9, 20, 32].

Similar to BLS data, workers' compensation claims are likely also affected by increased awareness of workplace violence in healthcare. One component of California's new standard is annual education for all healthcare staff to increase knowledge of the definition of workplace violence along with hands-on training for those in high-risk areas. It is likely that while workers' compensation claims still require a more serious incident to reach the level of reporting, improved detection and reduction in stigma associated with being victimized by workplace violence is likely to drive an apparent increase in incidents [7, 18]. These changes may not affect all workers universally, however, as definitions of violence and thresholds for what is reportable vary by workers' identities and workplace cultures. For instance, recent work exploring workers' compensation claims in Washington State found that workers experiencing greater job instability and adversity are less likely to access the workers' compensation system [34]. This introduces a challenge in interpreting findings from workers' compensation data and also points to the importance of providing support and education for workers across sectors in how to utilize available resources and supports when they face violence on the job.

A useful comparison for California workers' compensation data comes from Australia, where the publicly-funded Safe Work organization collects and analyzes detailed occupational health and safety data including workers' compensation claims [35]. Safe Work's 2024 report on workplace violence documents trends in violence-related workers' compensation claims over a similar study period, finding that workplace violence-related workers' compensation claims increased at triple the rate of other serious claims from 2017–2018 to 2021–2022 [36]. While they do not present findings of industry-specific trends over time, they do include data indicating that violence-related claims are significantly higher among health care and social assistance workers than those from all other sectors, with the number of claims nearly double the second-highest category (public administration and safety workers) [36].

As in California and across the globe, the period of Safe Work's analysis was affected by the COVID-19 pandemic, a disruption which altered the healthcare environment in profound ways. The multisector trends described in Australia indicate continued increases throughout the pandemic period and then a moderate reduction during 2021–22, a finding which was not mirrored in our analysis. So, while there is not a direct comparison for our findings, data like Safe Work's provide an example of how a more integrated approach to data collection can yield useful insights, particularly when new policy initiatives like California's are implemented. Further, Safe Work's approach offers additional data describing the specific types of incidents leading to workers' compensation claims and claimants' characteristics, helping healthcare leaders, advocates, and policy makers decide what types of mitigation strategies to prioritize.

4.2 | Types of Harm Workers Sustained

In addition to enumerating workplace violence incidents, another contribution this study offers is a description of the types of injuries healthcare workers sustain due to workplace violence. Violence can lead to many types of physical harm for impacted workers; musculoskeletal injuries and cuts or punctures were common during these incidents, as many occurrences involved staff members physically restraining or managing a patient during an episode of agitation. A recent study investigating California healthcare workers' compensation claims for a similar time period explored the relationship between workplace violence and mild traumatic brain injury, finding that 11% of such claims were due to violence [37].

Beyond immediate physical injuries, workplace violence research has illuminated the ways that an incident of violence can be experienced as traumatic for workers and those around them, leading to psychological and emotional harms [1, 2, 4]. Exposure to workplace violence affects the mental health and wellbeing of those who experience it, with findings including post-traumatic stress disorder, depression, and disengagement from work responsibilities [1, 38]. Recognizing that the psychological impact of these events can be consequential for workers' ability to remain employed in the workplace or even in the industry, policy support is needed to explore the capacity of the workers' compensation system to support psychological injuries caused by workplace violence. One recommendation which would facilitate better tracking of this persistent and consequential problem is to establish a code that captures

whether an incident was caused by workplace violence. This could help determine whether additional psychological support would be needed and help the assessor determine what resources should be offered to the worker. Workers' compensation claims administrators should consider this as an additional category and occupational health providers should also be provided education about priority interventions such as psychological support and counseling for this type of incident.

Workers' compensation data have the potential to yield useful insights, although claims are collected according to different rules by state and are not universally available for research [21, 39]. As multiple approaches to legislating safety for workers in high-risk sectors are enacted, it will be essential to track the impact of different regulatory approaches over time. Claims data are not always a reliable source of epidemiological information from a public health standpoint because their intended use is for accuracy in billing and fairness in compensation. At the same time, workers' compensation studies have the potential to demonstrate the direct financial consequences of injuries sustained on the job, helping inform priorities for leadership and other safety advocates as time away from work and payments to cover needed treatment are reflected in the system.

4.3 | Limitations

For this study, WCIS data present challenges both in identifying the industry workforce and in capturing violence-related claims. A subset of each type of claim identified using free-text analysis was reviewed to test for accuracy, but the chance remains that some were mis-classified, both in healthcare industry claim and in violence-related claim identification. Because of the historical recognition that undercounting is a concern in capturing this phenomenon, more inclusive approaches were undertaken.

In addition, the free text fields used for occupation description and injury description were character-limited, so providers could not elaborate on what could be relevant context for interpreting a claim. We have provided an accounting of our analytic approach both in the methods description and the supplements. A further limitation is that the assailant or perpetrator of violence cannot be readily identified from these data, which limits our ability to offer clear recommendations for prevention. California's legislation is designed to address multiple sources of violence towards healthcare workers, but effective interventions will differ depending on whether workers face greater risks from co-workers, clients, or those committing a crime.

5 | Conclusions

There is important momentum surrounding legislation supporting healthcare workers' health and safety. Workplace violence is one persistent aspect of what has become increasingly recognized as an untenable work environment for healthcare workers [40], leading many to contemplate leaving the profession altogether [41, 42]. Tracking the impact of this problem requires both an epidemiological approach and a local one. To document the extent of this problem overall and propose policy solutions, it is essential to have consistent and complete data collection and useful analysis that can provide evidence for

what approaches are working to keep health care workers safe. Workers' compensation is one possible channel for documenting the extent of the problem, but more specific strategies that can provide direct information for the rate of claims over time could provide a more coherent picture of the problem.

In addition, while it is important to capture the larger phenomenon of workplace violence to continually demonstrate its impact on the industry and patient care environment, it is also clear that workers within individual workplaces are often best positioned to argue for the most essential changes to the practice environment to keep themselves safe at work. A key aspect of California's legislation is for frontline staff to be involved in developing and monitoring practice changes to improve safety. For this reason, data tracking at the facility or otherwise local level is key for determining what specific aspects of practice change or legislation have the most impact on occurrence of violence, as statewide data may not be able to measure individual employers' and communities' accomplishments in violence prevention and reduction.

California has recently expanded its workplace violence prevention efforts to cover workers outside of healthcare. The state's new legislation for general industry workers went into effect in 2024, with new CalOSHA standards for these additional types of workplaces forthcoming [43]. The awareness of the ongoing risks workers face due to violence is an important first step towards safety, and it will be important to track the impact of violence which is reported through multiple available channels including workers' compensation. Workers and their employers both have an essential role to play in recognizing aspects of the patient care environment that are contributing to violence and taking steps to keep patients and staff safe at work.

Author Contributions

RO conceptualized the work, acquired the project funding and data for the project, led the interpretation of data, and drafted the initial version of the manuscript. SJL supported data acquisition, data analysis, and in specifying the analytic approach. OSH supported the proposal of this project, facilitated funding acquisition, and provided support in data interpretation. WK supported the interpretation of data and the analytic approach for the project. All authors provided critical revisions for the intellectual content and provided feedback on revisions of the manuscript. All approved the final version of the manuscript and agree to be accountable for the accuracy and integrity of this work.

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Ethics Statement

This study was approved by the University of Wisconsin-Madison Institutional Review Board (Project ID: 2023-1023), and the California Committee for the Protection of Human Subjects (the entity which oversees projects utilizing California's state-owned data; Project Number 2021-214). This study involved analysis of previously collected, de-identified, claims data and so informed consent was not required.

Data Availability Statement

The data that support the findings of this study are available from California Department of Workers' Compensation. Restrictions apply to the availability of these data, which were used under license for this study.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

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