


Workplace violence injury in 106 US hospitals participating in the Occupational Health Safety Network (OHSN), 2012-2015

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Background: Workplace violence is a substantial occupational hazard for healthcare workers in the United States.

Methods: We analyzed workplace violence injury surveillance data submitted by hospitals participating in the Occupational Health Safety Network (OHSN) from 2012 to 2015.

Results: Data were frequently missing for several important variables. Nursing assistants (14.89, 95%CI 10.12-21.91) and nurses (8.05, 95%CI 6.14-10.55) had the highest crude workplace violence injury rates per 1000 full-time equivalent (FTE) workers. Nursing assistants' (IRR 2.82, 95%CI 2.36-3.36) and nurses' (IRR 1.70, 95%CI 1.45-1.99) adjusted workplace violence injury rates were significantly higher than those of non-patient care personnel. On average, the overall rate of workplace violence injury among OHSN-participating hospitals increased by 23% annually during the study period.

Conclusion: Improved data collection is needed for OHSN to realize its full potential. Workplace violence is a serious, increasingly common problem in OHSN-participating hospitals. Nursing assistants and nurses have the highest injury risk.

KEYWORDS

healthcare workers, occupational injury, workplace violence

1 | INTRODUCTION

Workplace violence is a substantial and increasing occupational hazard for healthcare workers (HCWs) in the United States.¹⁻¹² Bureau of Labor Statistics (BLS) data indicate that in 2014, private sector HCWs were more than three times as likely to suffer a lost work day injury caused by workplace violence compared to all private sector workers combined.¹³ Indeed, the majority of lost work day occupational injuries resulting from

workplace violence in the United States occurred in the healthcare and social assistance industry sector.¹⁴ Workplace violence is also the leading cause of fatal occupational injury among HCWs in hospitals.¹⁵

Hospitals, along with psychiatric care and geriatric long term care settings, present the highest risk for workplace violence against HCWs.^{2,14} BLS data indicate that the rate of lost work day occupational injuries in United States general medical and surgical hospitals increased each year during the period 2011-2014, rising 34% from 5.0 per 10 000 full-time equivalent workers (FTE) in 2011 to 6.7 per 10 000 FTE in 2014.¹³ In psychiatric and substance abuse hospitals, the rate rose from 64.5 to 109.5 per 10 000 FTE during the same period.¹³

Specific occupational groups, nurses and nursing assistants in particular, are at higher risk than others as demonstrated in a 2014

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study of documented workplace violence incidents in a US hospital system.¹⁶ Furthermore, in a study of 112 hospitals participating in the National Institute for Occupational Safety and Health (NIOSH) Occupational Health Safety Network (OHSN), nursing assistants were more likely to experience workplace violence injuries than workers in other job categories and sustained more than twice the injury rate of nurses for workplace violence injuries.¹⁷

Within hospitals, certain departments or types of unit, including emergency departments,^{9,18,19} have been found to present increased risks for violence against HCWs. A 2015 NIOSH study also showed that, among OHSN-participating hospitals, workplace violence rates were highest in inpatient adult wards, outpatient urgent and acute care areas, emergency departments, and adult critical care departments.¹⁷

In hospitals, as in most other healthcare settings, workplace violence is most commonly perpetrated by patients or visitors,^{2,3,8,14,20–23} a category of workplace violence referred to by researchers as Type II violence.²²

In this study, we aim to provide an updated and more detailed analysis specifically of workplace violence injuries among workers in a non-random sample of US hospitals by analyzing data submitted by participating facilities to OHSN during the initial 4 years of its operation, 2012–2015. We describe the incidence and distribution of workplace violence events and associated risk factors among workers in OHSN-participating hospitals.

2 | MATERIALS AND METHODS

2.1 | Study design and population

To characterize the nature and extent of workplace violence injuries in OHSN-participating hospitals and to identify potential risk factors, we analyzed workplace violence injury surveillance data submitted to OHSN from January 1, 2012 through December 31, 2015. OHSN is a voluntary system created by NIOSH to enable inpatient healthcare facilities to promptly and securely track occupational injuries by injury type, occupation, location, and other factors and to share these data with NIOSH. Although it includes a diverse group of hospitals with considerable variety in terms of geographic distribution, urban versus rural location, medical school affiliation, facility size and type, OHSN was not designed to be a nationally or otherwise representative network of hospitals. At the time this study was conducted, OHSN enabled participating facilities to track any or all of three categories of traumatic injury to healthcare personnel: slips, trips and falls; musculoskeletal disorders resulting from patient handling and movement events; and workplace violence. Health care facilities upload existing, de-identified occupational injury data through OHSN's secure, web-based data portal. Participating facilities have the option either to use OHSN-provided data collection tools to record injuries reported by employees and contractors or to convert injury data files in their own preexisting databases to standard OHSN data elements using the OHSN data conversion tool upon upload. The OHSN data elements are designed to characterize first the occupation and other demographics of the injured worker; second, the type, severity, cause

and location of the injury; and finally, information on the circumstances surrounding the injury occurrence. Standardization of data across all facilities allows comparison within and among facilities.

As of the end of 2015, there were 116 facilities that participated in OHSN by submitting data on at least one occupational injury category for at least 1 year between 2012 and 2015. Participation in OHSN requires that facilities submit at least 3 months of data in a given calendar year. For this study, we included data from facilities that provided at least 3 months of data in a given year between 2012 and 2015. This study included data on all workers in participating health care facilities, with or without duties involving patient care. In our analysis, we described the distribution of workplace violence event characteristics and calculated incidence rates and incidence rate ratios for occupation, year, and selected hospital-level variables.

2.2 | Variables

The case definition used by OHSN facilities for reporting workplace violence events was based on the 2002 Framework Guidelines for Addressing Workplace Violence in the Health Sector. Workplace violence refers to "incidents where staff are abused, threatened or assaulted in circumstances related to their work, including commuting to and from work, involving an explicit or implicit challenge to their safety, well-being or health." While hospitals can report workplace violence injuries that do not meet Occupational Safety and Health Administration (OSHA) recordability criteria to OHSN, NIOSH only analyzes and reports on OSHA-recordable injury data. OSHA defines a work-related injury or illness as recordable if it results in death, unconsciousness, days away from work, restricted work, transfer to another job, or requires medical treatment beyond first aid. Work-related fractures of bones or teeth, punctured eardrums, cancers, and chronic irreversible diseases are also recordable. In addition, special recording criteria apply to work-related cases involving needlestick and sharps injuries; medical removal; hearing loss; and tuberculosis.²⁴

Variables used to describe the distribution of workplace violence injury characteristics included the age, sex, and occupation of the person who sustained the injury, as well as event location, severity (ie, injuries resulting in days away from work, job transfer, or restriction or other OSHA-recordable injuries), type of assailant (patient, worker, or visitor), and event type (verbal, assault against property, or physical assault to person).

Data on hospital-level characteristics, including the annually-updated number of overall and occupation-specific FTEs, were obtained from annual American Hospital Association member surveys.²⁵

Predictor variables used in the analysis of workplace violence injury rates included occupation, event year and five categorical, hospital-level variables: hospital type, hospital ownership (public vs private), hospital size (in terms of number of beds), urban versus rural location,* and affiliation with a medical school. We also included the ratio of nurse FTEs to average monthly admissions as a continuous hospital-level variable intended to serve as a proxy measure for staffing levels.

2.3 | Statistical analysis

We described the frequency and proportional distribution of workplace violence injury characteristics. As denominator data were unavailable by age, sex, or event location, we could not calculate rates for or evaluate the association of these factors with workplace violence. While it is possible, in principle, to calculate workplace violence injury rates by severity, type of assailant, and event type, these variables were “unknown” or “unspecified” for large proportions of events, which would undermine the validity of calculated rates and make interpretation difficult. Therefore, these variables are described by frequency and proportional distribution.

Workplace violence incidence rates were calculated as the number of injuries occurring per 1000 FTE workers. For OHSN purposes, a hospital's annual number of FTE is defined as the ratio of total employee-hours worked in a year to the number of hours normally worked by a full-time employee—2000, based on working 40 h per week and 50 weeks per year. Annual denominators for rates were calculated as the product of the number of FTE at a hospital and the number of months of observation, that is the number of months that the hospital reported data to OHSN, divided by twelve. Pooled mean incidence rates for groups of facilities were calculated as the total number of events occurring at all of the facilities of interest divided by the sum of the FTE denominators for the same facilities. Because OHSN facilities report occupation-specific as well as total numbers of FTEs each year, occupation specific incidence rates were calculated as well. Poisson-based 95% confidence intervals were calculated for all rates.

Bivariate incidence rate ratios (IRRs) and their 95% confidence intervals were calculated using Poisson regression to assess the association of occupation as well as event year and hospital characteristics with workplace violence injury rates. For categorical variables, the largest categories in terms of FTE or number of facilities were selected as referent groups with the exception of event year. In bivariable analyses, event year was analyzed as a categorical variable with 2012 as the referent.

Because our data consisted of events clustered within hospitals, all standard errors for incidence rates and bivariable IRRs were adjusted to account for correlated data by specifying hospital as a repeated measure in the Poisson regression model.

To evaluate the relationship between occupation and the rate of workplace violence events while controlling for the effect of event year and hospital characteristics, we modeled multivariable-adjusted IRRs using negative binomial regression. We used negative binomial rather than Poisson regression in the multivariable model because preliminary analyses suggested that the data were overdispersed. Additionally, because our data consisted of events clustered within hospitals, with some covariates measured at the hospital level, our model was partially ecologic. Therefore, to account for the hierarchical structure of the data, we fitted a generalized multilevel, multivariable model using the SAS GLIMMIX procedure to estimate adjusted IRR for all independent variables (fixed effects), while specifying hospital as a random effect. In the multivariable analysis, event year was analyzed as

a continuous variable to evaluate trend, with the IRR representing the average annual rate change over the study period.

All analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

2.4 | Ethics review and approval

The NIOSH Human Subjects Review Board determined that the activities in this study were conducted to provide information on how to tailor a proven-effective intervention, service, or program in a specific setting or context and did not meet the criteria of research according to 45 CFR 46.1101(b)(2).

3 | RESULTS

From January 1, 2012 to December 31, 2015, 106 of the 112 hospitals that participated in OHSN reported workplace violence surveillance data to OHSN in at least one calendar year of the study period. A total of 3263 OSHA-recordable workplace violence events were recorded by the OHSN-participating hospitals.

The distribution of workplace violence injury characteristics are presented in Table 1. By occupation, nurses in OHSN-participating hospitals sustained most workplace violence injuries ($n = 1311$ events, 40.2% of total events), followed by all other HCWs, including non-patient care personnel ($n = 1066$, 32.7%) and nursing assistants ($n = 647$, 19.8%). (Non-patient care personnel include environmental services, housekeeping, laundry, food service, security, administrative, and all other non-patient care staff.) Females sustained the majority of injuries, accounting for 66.4% ($n = 2165$) of all events. Inpatient care locations were the most common location of workplace violence injuries ($n = 1764$, 54.1%), followed by outpatient care locations ($n = 703$, 21.5%). Analysis of more detailed event location data (data not shown) reveal that, within inpatient care locations, the most common detailed locations for workplace violence events were adult wards ($n = 951$, 29.1% of total), followed by adult critical care units ($n = 241$, 7.4% of total) and behavioral health/psychiatric wards (222, 6.8% of total). Within outpatient care locations in OHSN participating hospitals, the most common detailed location of workplace violence injuries was the emergency department ($n = 629$, 19.3% of total). The most common areas where workplace violence events occurred were patient rooms ($n = 1723$, 52.8%), followed by corridors/elevators/stairwells ($n = 332$, 10.2%), and examination rooms ($n = 201$, 6.2%).

The majority of workplace violence events had either “unknown” or “unspecified” values for the variables, severity ($n = 2723$, 83.5%), type of assailant ($n = 2817$, 86.3%), and type of assault ($n = 1695$, 52.0%). However, among the 540 injuries where the severity was reported, 261 (48.3%) resulted in lost work days, job restrictions or transfers. Among the 446 events where the type of assailant was reported, patients were reported at the most common assailant, accounting for 94.8% ($n = 423$) of those injuries. Among the 1568 injuries where the type of assault was reported, nearly all, 98.5% ($n = 1229$), were physical assaults against the HCW.

TABLE 1 Characteristics of workplace violence events in 106 OHSN-participating hospitals, 2012-2015 (*n* = 3263)

Characteristic	Number of events (%)
Occupation	
Physicians, dentists, and interns	14 (0.4)
Nurses	1311 (40.2)
Pharmacists and pharmacy technicians	2 (0.1)
Nursing assistants	647 (19.8)
Radiology technicians	39 (1.2)
Laboratory professionals and technicians	32 (1.0)
Respiratory therapists	25 (0.8)
Other trainees	10 (0.3)
All others, including non-patient care staff	1066 (32.7)
Unknown or not specified	117 (3.6)
Sex	
Female	2165 (66.4)
Male	844 (25.9)
Unknown or not specified	254 (7.8)
Age group (years)	
<35	1422 (43.6)
35-54	1,371 (42.0)
≥55	470 (14.4)
Event location	
Inpatient	1764 (54.1)
Outpatient	703 (21.5)
Radiology	27 (0.8)
Non-patient care	263 (8.1)
Unknown or not specified	506 (15.5)
Severity	
OSHA recordable, Unspecified	2723 (83.5)
OSHA recordable, Days away from work	113 (3.5)
OSHA recordable, Job transfer or restriction	148 (4.5)
OSHA recordable, All other cases	279 (8.6)
Assailant	
Patient	423 (13.0)
Worker	8 (0.3)
Visitor	15 (0.5)
Other	0 (0.0)
Unknown or not specified	2817 (86.3)
Event type	
Unspecified	1695 (52.0)
Verbal assault	10 (0.3)
Assault against property	14 (0.4)
Physical assault to person	1544 (47.3)

OHSN, Occupational Health Safety Network; OSHA, Occupational Safety and Health Administration.

For the analysis of workplace violence incidence rates per 1000 FTE, we excluded one hospital's 2014 data, another hospital's 2015 data and all years' data from a third hospital due to unreliable denominator data; thus incidence rates are based on an analytic sample of 105 hospitals. Collectively, these 105 hospitals contributed 499 183 FTE during the study period, during which 3184 workplace violence events arose, corresponding to an overall workplace violence incidence rate of 6.38 events per 1000 FTE (95%CI: 4.45-8.31). Further analyses of workplace violence injury incidence rates by event and hospital characteristics were based on a total numerator of 3055 cases, however, because we excluded 129 events that could not be classified due to missing occupation or other covariate data.

Crude workplace violence incidence rates and bivariable IRRs by occupation, event year, and hospital type, hospital ownership, hospital size, location, and medical school affiliation are shown in Table 2. We also present the IRR for the nurse FTE to average monthly admissions ratio, the continuous staffing level proxy variable. Nursing assistants had the highest rate of workplace violence events followed by nurses and all other HCWs, including non-patient care personnel. Pharmacists and physicians had the lowest rates of workplace violence events. Compared to all other HCWs, including non-patient care personnel, nursing assistants, and nurses both experienced significantly higher rates of workplace violence. Pharmacists, physicians, and radiology technicians, on the other hand, all had significantly lower rates.

The overall workplace violence incidence rate among OHSN-participating hospitals increased from 4.4 injuries per 1000 FTE in 2012 to 7.6 in 2014 then decreased slightly to 7.2 in 2015. The annual rate in both 2014 (IRR 1.73, 95%CI 1.25-2.39, $P < 0.01$) and 2015 (IRR 1.63, 95%CI 1.10-2.43, $P = 0.02$) was significantly higher than the 2012 baseline (Figure 1).

Of the hospital characteristics we examined, hospital type, ownership, size, and location were significantly associated with the workplace violence injury incidence rate in bivariable analyses; medical school affiliation and staffing levels were not. General and children's medical and surgical hospitals had similar rates, but other types of facilities had significantly lower rates compared to general medical and surgical hospitals. Publically owned hospitals had significantly lower rates than privately owned hospitals. Compared with small hospitals, large hospitals had significantly lower rates. Compared with those in metropolitan areas, hospital in small urban (micropolitan) areas had significantly higher workplace violence incidence rates.

In the multilevel, multivariable model that took into account the effects of all covariates simultaneously, as well as the random effect of hospital, only occupation, hospital ownership and event year remained significantly associated with workplace violence incidence rates (Table 3). Nursing assistants had workplace violence incidence rates that were nearly three times that of all other HCWs, including non-patient care personnel (IRR 2.82, 95%CI 2.36-3.46). The rate for nurses was 70% higher than that of all other HCWs, including non-patient care personnel (IRR 1.70, 95%CI 1.45-1.99). Pharmacists (IRR 0.04, 95%CI 0.01-0.14), physicians (IRR 0.11, 95%CI 0.06-0.20), radiology staff (IRR 0.58, 95%CI 0.40-0.82), laboratory technicians (IRR 0.55, 95%CI 0.37-0.82), and

TABLE 2 Workplace violence injury incidence rates and rate ratios by occupation, year, and selected hospital characteristics in 105 OHSN-participating hospitals, 2012-2015

Characteristic	Number of hospitals (n = 105)	FTE (n = 499 183)	Events (n = 3055)	Rate per 1000 FTE (95% CI)	IRR (95%CI)
Occupation					
Physicians	105	22 986	11	0.48 (0.23-1.00)	0.10 (0.05-0.21)
Nurses	105	158 391	1275	8.05 (6.14-10.55)	1.74 (1.35-2.24)
Pharmacists	105	11 927	2	0.17 (0.04-0.67)	0.04 (0.01-0.15)
Nursing Assistants	105	41 432	617	14.89 (10.12-21.91)	3.21 (2.14-4.84)
Radiology Techs	105	14 057	38	2.70 (1.89-3.85)	0.58 (0.38-0.89)
Lab Techs	105	12 230	31	2.52 (1.51-4.23)	0.54 (0.28-1.05)
Respiratory Therapists	105	7625	23	3.01 (1.98-4.58)	0.65 (0.41-1.02)
Other Trainees	105	3213	5	1.44 (0.25-8.36)	0.31 (0.05-1.83)
Others, including non-patient care personnel	105	227 322	1053	4.63 (3.39-6.33)	Ref
Event year					
2012	79	112 448	496	4.41 (3.00-6.48)	Ref
2013	93	137 244	710	5.17 (3.62-7.37)	1.17 (0.93-1.47)
2014	98	127 731	974	7.62 (5.71-10.16)	1.73 (1.25-2.39)
2015	96	121 759	875	7.18 (5.60-9.20)	1.63 (1.10-2.42)
Hospital type					
General medical and surgical	99	479 269	2942	6.13 (4.62-8.15)	Ref
Children's general medical and surgical	2	17 562	109	6.20 (5.93-6.49)	1.01 (0.76-1.35)
Other	4	2352	4	1.66 (0.60-4.62)	0.27 (0.09-0.78)
Hospital ownership					
Public	3	9124	12	1.32 (0.53-3.28)	0.21 (0.08-0.55)
Private	102	490 059	3043	6.20 (4.71-8.17)	Ref
Hospital size					
Small (<200 beds)	56	72 157	492	6.79 (5.13-8.98)	Ref
Medium (200-499 beds)	37	224 023	1857	8.28 (6.27-10.95)	1.22 (0.82-1.81)
Large (≥500 beds)	12	203 003	706	6.79 (5.13-8.98)	0.51 (0.28-0.92)
Hospital location					
Large urban (Metro division)	16	118 901	777	6.53 (3.06-13.93)	1.12 (0.50-2.50)
Urban (Metropolitan)	73	361 781	2121	5.86 (4.44-7.73)	Ref
Small urban (Micropolitan)	6	9143	105	11.43 (6.38-20.49)	1.95 (1.02-3.72)
Rural (non-CBSA)	10	9357	52	5.54 (3.18-9.63)	0.95 (0.51-1.76)
Medical school affiliation					
No	58	102 774	739	7.17 (5.45-9.43)	1.23 (0.79-1.90)
Yes	47	396 409	216	5.84 (4.16-8.21)	Ref
Average ratio of Nurse FTE to admissions	105	-	-	-	0.21 (0.03-1.56) ^a

OHSN, Occupational Health Safety Network; FTE, full-time equivalent workers; CI, confidence interval; IRR, incidence rate ratio; Ref, referent; CBSA, core-based statistical area.

^aIRR reflects percent change in incidence rate per 1-point increase in the nurse FTE to monthly admissions ratio.

respiratory therapists (IRR 0.61, 95%CI 0.39-0.96) all had significantly lower workplace violence injury rates than other HCWs.

The workplace violence injury incidence rate in publicly owned hospitals was approximately 70% lower than privately owned hospitals (IRR 0.26, 95%CI 0.07-0.93).

Assuming a linear trend, the workplace violence injury incidence rate increased by an average of 23% (IRR 1.23, 95%CI 1.15-1.31,

$P < 0.01$) annually during the 4-year study period, a trend that was statistically significant.

4 | DISCUSSION

In this, the first study to focus on workplace violence using aggregated surveillance data from OHSN, we have summarized and characterized

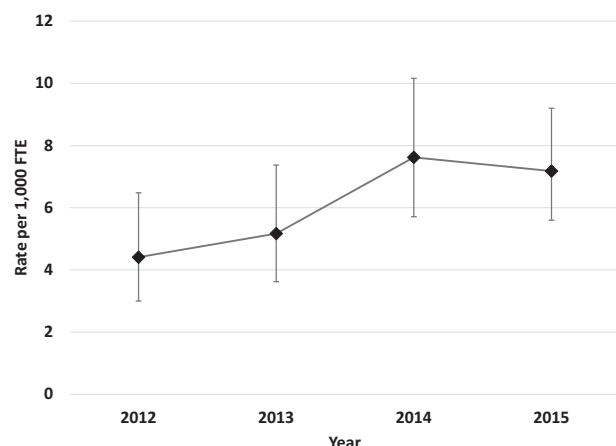


FIGURE 1 Trend in crude incidence rates (point estimates and 95% confidence intervals) of workplace violence injury among 105 OHSN-participating hospitals, 2012-2015

the experience of 106 US hospitals during the period January 2012 through December 2015. It is also an opportunity to draw some initial lessons from the first four years of OHSN's operation. Our analyses indicate that chief among these lessons is the need for improved and more complete collection of data on several characteristics of workplace violence events. The majority of workplace violence events had either "unknown" or "unspecified" values for the variables severity, type of assailant, and type of assault—variables critical to both understanding and preventing workplace violence. We cannot discern from the data whether this information truly was not or could not be ascertained of these events or whether the data were available but either never recorded or never entered in hospitals' electronic data collection systems and thus never submitted to OHSN. But it is clear that focused efforts on the part of both participating hospitals and OHSN should be undertaken to improve data collection. In the former case, more investigatory resources need to be brought to bear by hospitals' occupational health personnel when workplace violence events occur. In the latter, improved data collection tools and informatics systems should be developed and implemented. Effective prevention depends on useful surveillance data and OHSN will not be able to realize its full potential as a prevention resource without improved data collection and reporting on the part of hospitals.

Our analysis of event characteristics that were reliably collected indicates that workplace violence is a serious and increasingly common problem in participating hospitals and that nurses and nursing assistants are at the highest risk for injury. Workplace violence in healthcare generally, and in hospitals, in particular, has been recognized as an important occupational hazard for more than 2 decades.^{11,12,26-29} The rate of such injuries in hospitals, however, continues to increase more steeply than does the rate for all US industries combined. The rate of non-fatal workplace violence injuries involving days away from work in US private sector hospitals rose 39% from 6.4 per 10 000 FTE in 2011 to 8.9 per 10 000 FTE in 2014.¹³ By comparison, the rate for all US private sector industries increased 31% from 1.3 to 1.7 per 10 000 FTE during the same period.¹³

The 105 OHSN-participating hospitals included in our analysis also experienced an increase in the rate of workplace violence injuries during approximately the same time period, rising 72% from 4.4 injuries per 1000 FTE in 2012 to a high of 7.6 per 1000 FTE before declining slightly to 7.2 in 2015. The reasons for the increasing workplace violence injury rates is unknown and deserves further investigation but could include changes in patient factors—for example increasing prevalence of substance abuse, mental illness, dementia, or other medical conditions that may cause cognitive impairment or aggression—or work organization factors—for example, understaffing, long patient wait times, high staff turn-over. During the study period, the adjusted workplace violence injury rate increased an average of 23% each year. This finding, which is based on a 4-year time window and makes the assumption that the trend is linear, may not hold over a longer time period. It is also possible that some of this increase may have been due to the increased awareness and better reporting on the part of both individual HCWs and participating hospitals that ongoing participation in OHSN is intended to bring about, the observation of a concomitant increase reflected in BLS data from 2011 to 2014 (lagging OHSN data by 1 year) suggests the occurrence of a true increase.

In our analysis of OHSN-participating hospitals, we found that nurses and nursing assistants bore the vast majority of the burden of workplace violence injury. Indeed, these were the only occupational groups we found to have significantly higher risk of workplace violence injury relative to all other HCWs, including non-patient care hospital personnel in both bivariate and multilevel, multivariable-adjusted analyses. Both nurses and nursing assistants were at increased risk of workplace violence injury but, while nurses accounted for the most workplace violence injuries with 40% of all cases, nursing assistants had by far the highest rate of injury. These findings are broadly consistent with those found in the published literature and with national surveillance data.³⁰

A 2014 study conducted in a large Midwest hospital system found that nurses accounted for 39.8% of workplace violence injuries, security staff 15.9% and nursing assistants 14.4%,³¹ closely approximating our findings. An earlier analysis of workplace violence surveillance data from that same hospital system also had findings very similar to ours, observing that, while nurses accounted for the largest number of workplace violence cases, mental health technicians (who are not distinguished from nursing assistants in OHSN), and patient care associates (categorized as nursing assistants in OHSN) had the highest rates of workplace violence injury followed by nurses.²¹

Hospital nurses' substantial excess risk of injury from workplace violence has been well documented.^{3,32-37} Nursing assistants' substantial workplace violence injury risk—particularly in long-term care settings where they are the predominant HCWs—has also been well documented.³⁸ BLS statistics from 2014 indicate that, across all settings, nursing assistants' workplace violence injury rate was 31.3 per 10 000 FTE, over ten times the rate for all occupations combined.¹³ With the exception of the above mentioned studies by Arnetz et al,^{21,31} fewer published data are available describing workplace violence injury rates for nursing assistants working in hospitals. Our study, along with those of Arnetz et al, suggests the possibility of an

TABLE 3 Multivariable-adjusted workplace violence injury incidence rate ratios by occupation, year, and selected hospital characteristics in 105 OHSN-participating hospitals, 2012-2015

Characteristic	Adjusted IRR (95% CI)
Occupation	
Physicians	0.11 (0.06-0.20)
Nurses	1.70 (1.45-1.99)
Pharmacists	0.04 (0.01-0.14)
Nursing Assistants	2.82 (2.36-3.36)
Radiology Techs	0.58 (0.40-0.82)
Lab Techs	0.55 (0.37-0.82)
Respiratory Therapists	0.61 (0.39-0.96)
Other Trainees	0.92 (0.38-2.26)
Others, including non-patient care personnel	Ref
Hospital type	
General medical and surgical	Ref
Children's general medical and surgical	1.48 (0.37-5.96)
Other	0.20 (0.04-0.98)
Hospital ownership	
Public	0.26 (0.07-0.93)
Private	Ref
Bed size	
Small (<200 beds)	Ref
Medium (200-499 beds)	0.91 (0.55-1.51)
Large (≥500 beds)	0.59 (0.29-1.22)
Hospital location	
Metro division	1.17 (0.69-1.99)
Metropolitan	Ref
Micropolitan	1.09 (0.45-2.63)
Rural (non-CBSA)	0.75 (0.35-1.64)
Medical school affiliation	
No	0.87 (0.52-1.44)
Yes	Ref
Event year (2012-2015)	1.23 (1.15-1.31) ^a
Avg ratio of Nurse FTE to admissions	0.86 (0.25-2.98) ^a

IRR, incidence rate ratio; CI, confidence interval; Ref, referent; CBSA, core-based statistical area.

^aIRR reflects change in incidence rate per 1-point increase in the exposure variable.

underappreciated disparity in workplace violence injury rates between nurses and nursing assistants in the hospital setting.

It is important to note, however, that our analysis of occupation-specific workplace violence injury rates could not be done at the department or unit level because only facility-wide denominator data were available. The wide disparity between nurses' and nursing assistants' workplace violence injury rates may not exist at the unit level, that is, when exposure is taken into account. Most hospitals

employ nurses in a number of positions that involve little or no patient contact, for example, administration, training, education, and quality assurance. This is not often the case with nursing assistants. It is also possible that nursing assistants are disproportionately assigned to high risk settings. The inclusion of nurses working in lower risk settings—rather than occupation-specific differences (other than the opportunity to work in a wider variety of positions)—could account for the observed difference in their workplace violence injury rates relative to nursing assistants. In equivalent exposure settings (eg, at the unit level), the observed disparity may be attenuated or not exist at all.

A number of risk factors for workplace violence in healthcare settings have been identified: patient (eg, cognitive impairment, substance abuse), situational (eg, transporting patients, poor lighting), and organizational (eg, long wait times, understaffing, high staff turnover).^{3,7,14,22,31,39} Many of these are likely to apply disproportionately to both nurses and nursing assistants. But the fundamental mechanism underlying both nurses' and nursing assistants' high workplace violence injury rates is likely to be their more frequent, prolonged, and direct exposure to patients compared with other hospital workers.²

The majority of workplace violence in United States hospitals is Type II violence, where the assailant is either the object or recipient of services (ie, the patient).^{2,3,8,14,20-23} In our analysis, the identity of the assailant was rarely reported. Nevertheless, there is some evidence from the data to suggest that the predominance of Type II violence holds true of OHSN-participating hospitals too. First, in the 15% of cases where the assailant type was reported, 95% were patients. Second, over three quarters of reported workplace violence injuries occurred in patient care areas (inpatient, outpatient, radiology). Our finding that the most common known departments where workplace violence injuries occurred were adult wards, the emergency department, critical care units, and behavioral health/psychiatric wards is also consistent with findings from the existing literature.^{2,22} Finally, nearly 60% of workplace violence injuries occurred in locations where direct patient care is performed, including patient rooms (52.8%), and examination rooms (6.2%). Without improved data collection, however, we cannot with any confidence evaluate whether this is actually the case.

Other than the identification of location in high-crime areas as a risk factor,¹⁴ relatively little is reported in the literature about the association of hospital-level characteristics with the risk of workplace violence injury, although several work-organizational factors, including inadequate staffing, long patient wait times, poor safety culture, and a lack of staff empowerment and shared governance have also been associated with increased risk of workplace violence.^{3,39} In a study of 138 Veterans Administration facilities Mohr et al,⁴⁰ observed that facilities located in urban areas, with larger bed sizes and without teaching hospital affiliations, had higher workplace violence rates.

In bivariate analyses, four of the six hospital characteristics we examined—hospital type, ownership, size, and location—were associated with the risk of workplace violence injury, but mostly not in ways that would fit plausible hypotheses about the relationship of hospital characteristics with workplace violence injury risk. OHSN-participating hospitals other than general medical and surgical or children's

hospitals had significantly lower workplace violence injury rates compared with general medical and surgical hospitals. This is at odds with evidence that psychiatric and rehabilitation hospitals typically have higher workplace violence injury rates than general medical and surgical hospitals.¹³ The three publicly owned hospitals in our sample had significantly lower workplace violence rates than private hospitals, which is inconsistent with national data suggesting that workplace violence rates are higher for HCWs in the public sector.¹³ Compared with small hospitals, large hospitals had significantly lower workplace violence injury rates. The lack of a consistent "dose-response" (in either direction) relationship between hospital size and workplace violence argues against the temptation to imagine either that larger, busier hospitals with more and higher-acuity patients are at higher risk or that smaller hospitals with fewer prevention resources are at higher risk. Small urban (micropolitan) hospitals had higher workplace violence injury rates relative to urban (metropolitan) hospitals, which is inconsistent with the idea that hospitals in more urban areas that might be in closer proximity to or serve high-crime areas would be at higher risk. A prospective study by Kowalenko et al,⁴⁰ found that workplace violence rates for emergency department personnel in suburban (ie, micropolitan) hospitals were similar to those of emergency department workers in urban hospitals and level-one trauma centers. Unlike Mohr et al,⁶ we did not find medical school affiliation to be associated with workplace violence rates.

Our multivariable model simultaneously adjusted for the effect of each of these hospital-level factors, as well as occupation, study year, and the random effect of hospital. Only one, hospital ownership, remained significantly associated with the individual, person-level risk of workplace violence injury, with public hospitals having lower rates. However, only three of the hospitals in the OHSN sample were publicly-owned. Occupation and study year (ie, trend) remained as significant predictors of risk, with nurses and nursing assistants being at increased risk and physicians, pharmacists, respiratory therapists, lab, and radiology technicians being at lower risk relative to non-patient care personnel. Average risk across all occupations increased each year.

5 | LIMITATIONS

This study is subject to at least five limitations. First, OHSN is a non-random sample of hospitals that voluntarily shared their workplace violence surveillance data with NIOSH as member of the Occupational Health Safety Network, not a probability sample designed to be representative of all US hospitals. Therefore, all estimates apply only to OHSN-participating hospitals and are not necessarily generalizable to other hospitals or hospital populations. Voluntary participation may have biased our sample in favor of best-practice facilities with established prevention programs or, conversely, in favor of hospitals whose participation in OHSN is part of an effort to address known, preexisting workplace violence problems. The former could have led to underestimates of workplace violence rates relative to US hospitals on average, while the latter could have led to overestimates.

Second, while OHSN provides tools to facilitate hospital reporting, some facilities still may not report all injuries, especially facilities that operationalize the workplace violence case definition differently or incorrectly. Furthermore, individual HCWs also may not report all injuries to their employers. Underreporting of workplace violence in a well-documented problem generally,⁴¹ and among HCWs in particular.^{31,42} Both factors could have resulted in underestimates of workplace violence rates and could also have confounded associations with putative risk factors as well.

Third, data on several important characteristics (eg, severity, assailant, type of assault) of workplace violence injuries was either missing or categorized as unspecified in the majority of cases, precluding drawing conclusions based on these variables.

Fourth, while OHSN workplace violence event (numerator) data are reported by department, denominator data are only reported for the hospital as a whole. As a consequence, department-specific rates could not be calculated, only event counts. Therefore, risk comparisons across departments could not be made. Facility-level rates are of limited value because workplace violence events are known to be more likely to occur in certain departments (eg, Emergency Department, psychiatric units) than in others.^{5,9,18,21} Comparing departments on the basis of event counts can provide information on burden but not on risk and, as mentioned before, the inability to take department or unit-specific exposure into account could confound occupation-specific risk estimates.

Finally, small sample size may have limited the ability to detect some associations, especially in subgroup analyses.

6 | CONCLUSION

Lessons learned from an analysis of data from the first four years of OHSN's operation include the need for improved and more complete collection of data on several characteristics of workplace violence events (eg, severity, assailant, type of assault) critical to both understanding and preventing workplace violence on the part of hospitals. Focused efforts on the part of both OHSN and participating hospitals should be undertaken to improve data collection. Future development of the capacity of OHSN to produce department-specific rates should also be considered. Implementation of these measures, resulting in more robust reporting with fewer unknowns and the ability to conduct department-specific risk evaluations will improve the utility of OHSN as a prevention tool for hospitals and researchers.

Findings from our analyses also indicate that nurses and nursing assistants had substantially higher risk for workplace violence injury than other occupations, with nurses accounting for the greatest number of workplace violence injuries and nursing assistants having the highest overall rate of workplace violence injury. We also found that, across all occupations, the average risk of workplace violence injury increased annually by 23%.

The former points are perhaps most important because effective prevention depends on useful surveillance data. Evidence from studies of hospital-level workplace violence prevention interventions has

been mixed.^{2,43} There is some evidence for the effectiveness of certain administrative measures such as “flagging” the files of patients with a history of violence against HCWs^{3,44} and more recent research suggests that comprehensive, data-driven prevention programs that include educational, organizational, medical, and structural components may reduce the incidence of workplace violence.^{1,6,18,45} However, more empirical evidence is needed to support the efficacy of most elements of the currently proposed strategies for reducing workplace violence and to identify the most promising among them.² Importantly, the provision of workplace violence surveillance data to unit managers played a central role in what is perhaps the best supported workplace violence intervention to date: the Hazard Control Matrix, which was shown to decrease the risk of Type II violence in hospitals in a recent randomized controlled trial.¹ While proposed workplace violence interventions await further validation in scientific studies, OHSN must focus efforts on improved workplace violence data collection and reporting to help determine where interventions are most needed and which approaches work best.

AUTHORS' CONTRIBUTIONS

MRG contributed to the design of the survey, interpreted data, performed statistical analysis, drafted and revised the manuscript, and is responsible for all aspects of the work. RFRS contributed to the design of the survey, interpreted data, assisted with the statistical analysis, and helped revise the manuscript. AG conceived of and contributed to the design of the study, interpreted the data, and helped draft and revise the manuscript. KV, WR, and SN all contributed to the design of the survey, interpreted the data, and helped revise the manuscript. All authors approved of the final version of the manuscript.

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The NIOSH Human Subjects Review Board determined (HSRB 10-DSHEFS-NR03) that the activities in this project were conducted to provide information on how to tailor a proven-effective intervention, service, or program in a specific setting or context and did not meet the criteria of research according to 45 CFR 46.1101(b)(2) and CDC Guidelines for Defining Public Health Research and Public Health Non-Research.

DISCLOSURE (AUTHORS)

The authors declare no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

Rodney Ehrlich declares that he has no conflict of interest in the review and publication decision regarding this article.

DISCLAIMER

The findings and conclusions in this article have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.

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