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Preventing patient-to-worker violence in hospitals: outcome of a randomized controlled intervention

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Abstract

Objective—To evaluate the effects of a randomized controlled intervention on the incidence of patient-to-worker (Type II) violence and related injury in hospitals.

Methods—Forty-one units across 7 hospitals were randomized into intervention (n=21) and control (n=20) groups. Intervention units received unit-level violence data to facilitate development of an action plan for violence prevention; no data were presented to control units. Main outcomes were rates of violent events and injuries across study groups over time.

Results—Six months post-intervention, incident rate ratios of violent events were significantly lower on intervention units compared to controls (IRR 0.48, 95% CI 0.29-0.80). At 24 months, the risk for violence-related injury was lower on intervention units, compared to controls (IRR 0.37, 95% CI 0.17-0.83).

Conclusion—This data-driven, worksite-based intervention was effective in decreasing risks of patient-to-worker violence and related injury.

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Keywords

Workplace violence; healthcare workers; intervention; participatory action research

BACKGROUND

Hospital employees in the United States have a higher risk of injury from violence compared to workers in other industries, with most of the violence attributed to patients.[1,2] In the U.S., industry data on the rates of workplace violence-related injuries are stratified by state, local, and private sectors. Within the state and private sectors, hospitals have violence-related injury rates that are more than 4 times greater compared to their sector overall: state hospitals 154.0 injuries/10,000 full-time equivalents (FTEs) vs. 32.1 injuries/10,000 FTEs for the state sector overall; private hospitals 16.8 injuries/10,000 FTEs vs. the overall private sector rate of 4.0/10,000 FTEs.[3] Rates of injury due to workplace violence have increased in recent years in U.S. hospitals, from 14.1/10,000 FTEs in 2011 to 16.8 in 2014.[3] Workplace violence also accounts for nearly one-half of fatal occupational injuries in U.S. hospitals.[4] Patient violence towards hospital workers threatens employee health and safety[5,6] and has been associated with decreased productivity[7,8] and quality of care[9] and increased employee turnover.[10] To date, violence intervention studies in healthcare settings are limited by methodological weaknesses, such as small sample sizes, use of convenience samples, and lack of control groups.[11-13] Critically, none has succeeded in demonstrating a significant decrease in the incidence of violence over time.[14-16] In contrast, the current project used a randomized block design to evaluate an intervention aimed at reducing hospital violence by prospectively tracking population-based incidence rates of patient-to-worker violence and related injury.

Patient-to-worker violence: impact on hospitals and hospital employees

In general hospitals, violence from patients and patient visitors, also known as Type II violence,[17] is a serious occupational hazard.[5,18,19] Certain environments, such as emergency departments[20,21] and mental health units[22] are at increased risk for Type II violence, as are frontline staff, including nurses,[22,23] physicians[20] and patient care associates.[22] Security staff, who often intervene in efforts to protect both worker and patient safety, are frequently injured in incidents with violent patients.[24] Patient violence may result in physical injury that can be serious for the individual worker and costly for the hospital.[23,24] However, even violent events that do not result in physical injury can take their toll on employee well-being, resulting in reduced work satisfaction,[23] increased turnover,[10] and psychological sequelae including sleep disorders, depression, and post-traumatic stress disorder.[8] Studies have also suggested that healthcare workers exposed to violence from their patients become more cautious and are on their guard when caring for patients.[9] This increased detachment and lack of involvement in one's work[25] has been associated with decreased quality of care.[9]

Workplace violence interventions in health care settings

There have been numerous interventions aimed at reducing patient violence. A systematic literature review of violence intervention studies in healthcare settings revealed that most

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had methodological weaknesses, with the primary ones being lack of statistical power and control groups.[13] Some studies[26,27] have employed control facilities and evaluated their intervention using staff self-reports. Others also utilized documented events[27] and examined the effects of a patient violence risk assessment system on hospital violence incident rates.[28] Using incident reports reduces recall bias, however none of those studies were randomized. Arnetz and Arnetz[14] conducted the only large-scale, randomized controlled workplace violence intervention in a healthcare setting. However, their study, like other non-randomized interventions[15] was evaluated on the basis of retrospective self-reports of violent events and/or injuries. Such studies are prone to recall bias, reducing the validity of the findings. Importantly, those previous interventions reported an *increase* in reported violent events, rather than the intended decrease.[14-15] This has been attributed to enhanced awareness of workplace violence among study participants, leading to an increased tendency to report.[14,15] Underreporting of workplace violence events is consistently cited in the literature and poses a serious hindrance to the evaluation of intervention effectiveness, as it is difficult to know the true extent of the problem. [8,29] Yet a recent pre-post intervention study aimed at increasing the reporting of workplace violence in a single emergency department in fact resulted in a decrease in overall reporting.[27] Clearly, there is a critical need for violence prevention interventions that utilize rigorous methods in both study design and evaluation.

Data-driven intervention

The conceptual foundation for the intervention design in the current study was the Plan-Do-Study-Act model first developed by Deming for manufacturing[30] and subsequently applied to health care.[31] These principles of continuous quality improvement are based on the use of succinctly summarized empirical organizational data used to analyze the need for change as well as to measure the subsequent degree of improvement.[32] This data-driven process has been applied in hospitals,[33,34] nursing homes,[35] and primary care[36] and has been shown to be effective in improving both employee work environment and patient-rated quality of care over time. In each of those studies, survey data for relevant measures were presented for each individual work unit in comparison to corresponding data for the entire organization. Based on the data, the individual units were given the task of identifying areas for improvement and implementing local improvement measures. Possible effects of those unit-level changes were analyzed in follow-up surveys.[33-36]

The intervention in the current project also was designed to be data-driven and unit-based, and utilized the strategy of comparing unit-level data with that of the entire hospital system. However, the data in the current project were comprised of population-based rates of reported violent events, rather than cross-sectional self-report surveys. Utilizing rates of occurrence makes it possible for a health care organization to compare the incidence of violence across individual multiple work units and hospitals, as well as over time.[22] An additional unique key aspect was the involvement of hospital stakeholders, representing both management and labor, in the development and execution of the intervention.[37] Stakeholder involvement in this participatory action research project helped to ensure that the intervention process would be as practical and feasible as possible, increasing the probability of sustainability. The aim of this study was to evaluate the impact of an intervention aimed at

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reducing hospital violence by prospectively tracking population-based incidence rates of patient-to-worker violence and related injury.

MATERIALS AND METHODS

Setting and participants

The study was conducted within a multi-site hospital system in the Midwest United States with approximately 15,000 employees and a system-wide electronic database for reporting workplace violence events. Workplace violence is defined by the hospital system following Occupational Safety and Health Administration criteria[38] as any type of physical or non-physical violence, including physical assault, verbal abuse, bullying, harassment or intimidation directed towards hospital employees. The hospital system mandates that employees report all acts of violence, either via the electronic reporting system or verbally to one's supervisor. Unit supervisors are mandated to register all reported violent events into the electronic system within 24 hours of the shift during which they received the verbal report.[24] Prior to this study, the research team had worked with the hospital system to develop methodology for calculating rates of workplace violence based on the total population at risk. Linking the electronic violence database with the human resources database, with identifiers removed, enabled the team to utilize employee paid productive hours in calculating incidence rates of violence per 100 FTEs. Paid productive hours consist of the regular and overtime hours when an employee is actually working; they do not include non-productive hours such as holiday, vacation, or sick time. Rates of violence thus became standardized, enabling hospital management to compare violence occurrence across hospitals and work units.[22,39] The population-based rates of workplace violence were the foundation for the current intervention project. The project utilized a Participatory Action Research approach[40] that involved active collaboration with hospital system representatives of occupational health, safety, nursing, security, human resources and labor.

Ethical approval for this study was granted by the Institutional Review Board at Wayne State University and the Research Review Council of the hospital system. Informed consent was not obtained from hospital employees since the data set was de-identified and researchers had no ability to link specific incident reports to individual employees.

Study design

The study was designed as a randomized, controlled intervention and utilized a mixed-methods approach. It was comprised of 4 phases:

Phase 1: Development of standardized reports of workplace violence—Using focus group discussions to gather preferences for content and format, standardized computer-generated reports of workplace violence data were developed based on the specifications of hospital system stakeholders.[37] Reports included rates of violent events based on reported incidents; rates of violence-related injuries based on workers' compensation claims; and descriptive characteristics of documented violent events.

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Phase 2: Implementation of the Hazard Risk Matrix to prioritize hospital units for intervention—The Hazard Risk Matrix[41] was used to identify hospital work units at increased risk for violence across the hospital system's 7 hospitals. The matrix enabled the simultaneous examination of workplace violence probability (likelihood of occurrence) and severity (likelihood of worker injury). System-wide workplace violence data from 2010-2012, along with cost data for violence-related injuries were summarized at the work unit level using the reports developed in Phase 1. Analyses were limited to hospital-based units, excluding other types of care units such as community convalescent centers. Using the matrix, hospital units with at least 5 violent events per100 FTEs recorded were categorized as low, medium, or high regarding violence probability (incidence rates) and severity (lost time injury costs). Work units falling in the upper diagonal were categorized as high or medium probability and/or severity and identified as being at increased risk for workplace violence. Thus a high probability of either incidence or injury was sufficient for a unit to be considered high risk. Out of a total of 1159 units across all 7 hospitals, 41 units were identified and prioritized for the intervention. Results of the categorization were reviewed with hospital stakeholders who had good knowledge of the hospital units and could address the possible confounding of underreporting and in fact identified an emergency department that had been categorized as low probability and medium severity; that unit was added to the study population for a total of 42 units. A detailed description of the implementation of the hazard risk matrix has been previously reported.[24]

Phase 3: Randomized intervention—The identified units were stratified by type of patient care into 6 blocks: acute care nursing, intensive care nursing, emergency department, psychiatry, security and surgery. Units were then sorted by their number of FTEs. Within each block, pairs of units based on this sorting were randomly assigned into intervention (n=21) and control (n=21) groups. Sorting units based on the number of full-time equivalents helped to ensure that the intervention and control groups would be comparable in size.

The intervention was designed to be data-driven and unit-based and was comprised of a worksite visit, or "walkthrough."[26,42] Walkthroughs were conducted during daytime hours on one single occasion on each of the 21 intervention units over a 6-week period from August 30 to October 16 in 2013. The walkthrough was designed to take no more than 45 minutes so as to minimize disruption to clinical care. No walkthroughs were scheduled during night time hours, since unit supervisors, who were key participants in this intervention, were most often not on duty. Walkthroughs were scheduled directly with unit supervisors, who could include one or two staff members if desired. During the walkthrough, researchers and stakeholder representatives (a group of 3-4 individuals) met with unit supervisors who were presented with a summary of the last three years' of workplace violence data for their unit compared to corresponding data for the entire hospital system. The report included the overall rates for workplace violence per year as well as the injury cost rate, based on workers' compensation data, as a measure of injury severity. Additional unit-specific data that were presented included type of incident, job category of employee involved, and location within unit/hospital. All data were presented in user-friendly graphic format based on hospital stakeholder specifications revealed in project

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phase 1.[37] Based on the data, supervisors were asked to work with their staff to develop an "Action Plan" for reducing workplace violence using an adapted version of an existing checklist[42] listing possible violence risk factors and evidence-based Administrative, Behavioral, and Environmental strategies for violence reduction.[43] The walkthrough team played no role in determining the specific change processes or prevention measures that were implemented on the intervention units. No walkthroughs were conducted on control units, where clinical activities continued as usual.

Phase 4: Intervention evaluation—The total study time period was 5 years, from September 2010 to October 2015, encompassing 3 years pre-intervention and 2 years post-intervention. For analysis purposes, data were collected in 6-month intervals both pre- and post-intervention. Evaluation was based on incidence rates of Type II violence and rates of violence-related injury at 6, 12, 18 and 24 months post-intervention. Rates at each respective post-intervention time period were compared to baseline, which included 6 six-month data points in the 3-year pre-intervention period September 2010-August 2013. Intervention fidelity, defined as the degree to which an intervention is actually followed as intended[44] among intervention units was examined by reviewing the number and nature of Action Plans returned to the research team. Additionally, an online follow-up survey among unit supervisors in all study units, both intervention and control, was conducted one-year post-intervention. The survey's purpose was to determine the degree to which the intervention units had implemented their planned strategies, and whether control units had also implemented any violence prevention measures during the course of the study.

Data analysis

Incidence rates for each group (intervention vs. control) were calculated as the number of events per 100 FTEs. FTEs were calculated as the number of paid productive hours divided by 2080, which is the total number of hours worked by an FTE in one year. Paid productive hours were obtained by hospital system data analysts by linking the database of violent events to the hospital system's human resources' database.[22,24] Thus, numerator data (i.e., number of incidents) obtained from the central reporting system were linked with the human resource database in order to obtain denominator data (i.e., FTEs). Paid productive hours, and thereby FTEs, are only available at the individual level. Employees are identified in the human resource database via their assigned work units, and rates of violent events and injuries are then generated for units. Thus, the system is designed to monitor rates of violence by hospital unit, which may not necessarily be where the violent event occurred.[24] For security staff, reported incidents were coded as "Security," even though the incidents occurred elsewhere in the hospital.

Chi square analyses were performed to test if there were any differences in demographics between employees in the intervention group versus those in the control group. Generalized estimating equations (GEE) with robust standard errors were used to test if the intervention were associated with subsequent reported Type II violence events and related injuries over time. Violent events included all documented incidents of violence, with or without injury. All injuries, including Workers' Compensation cases, are processed centrally through the Loss Time Management department. Violence-related injuries were a subset of violent

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events where a loss time management claim was initiated and the employee was seen in the employee health clinic. GEE was chosen due to the clustering of employees within work units as it is able to account for the nesting and provide appropriate standard errors and confidence intervals for coefficients. Due to the nature of the data, i.e., relatively rare events with large numbers of employees with zero events, the assumption of the variance being equal to the mean for Poisson regressions was not met. Consequently, a negative binomial error structure with log link was employed in the GEE analyses. For the analyses, the total time of 5 years was divided into segments consisting of the 3-year baseline period and 6, 12, 18, and 24-months post intervention. To represent changes over time, dummy coding was used. The 3-year period prior to the intervention period (September 2010-August 2013) was used as the baseline reference period when calculating incident rate ratios (IRRs) to compare rates across study groups over time. The 3-year baseline period consisted of six separate 6-month intervals. Each of these six intervals was included as separate time points in the analyses which were coded together as the reference group. This allowed the variability across the six baseline periods to be included in the analyses. Thus, analyses accounted for variation within and between units at each time interval both pre and post-intervention. Incident rate ratios and their 95% confidence intervals of the pre-post change both within and between groups were calculated for events and injuries, respectively. Incidence rates were based on the total number of events during each six-month time period. While not common, an employee may have experienced more than one incident during any six-month period.

Due to the recognized issue of underreporting of workplace violence among hospital staff,[8] an investigation of the magnitude of underreporting was conducted pre-intervention.[29] At baseline, the rate of violence underreporting did not differ significantly between the intervention (89.2%) and control (87.4%) groups (p=0.65). All analyses were conducted using SPSS 22.

RESULTS

A flow diagram depicting enrollment, randomization and follow-up of study participants (units) is illustrated in Figure 1. One unit from the control group dissolved shortly after the units were randomized and was deleted from all analyses, which were thus based on 41 units in total. Characteristics of the hospital workers in the 41 study units during the baseline period are summarized in Table I. There were significant differences between employees in the intervention and control groups in their gender, age group, job category and unit block. Intervention group employees were younger (54% vs. 48% <40 years), more likely to be in an acute care nursing unit (44% vs. 36%) and less likely to be in an intensive care nursing unit (7% vs. 13%).

Rates of violent events

Rates of violent events across the 5-year study period are compared by study group and illustrated in Figure 2. Table 2 compares the rates of Type II workplace violence within and between the study groups over time. There were no significant differences in rates of violent events between the intervention and control groups at any of the pre-intervention time points

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(baseline). At 6 months post-intervention, incident rate ratios of violent events were significantly lower on intervention units compared to controls (IRR 0.48, 95% CI 0.29-0.80). Rates of violence had decreased slightly in the intervention group, although not significantly, from 8.05/100 fulltime equivalents (FTEs) to 6.71/100 FTEs (IRR 0.83, 95% CI 0.56-1.24) and increased significantly in the control group from 8.32 to 14.36/100 FTEs (IRR 1.72, 95% CI 1.25-2.37). There were no significant group differences in rates of violence compared to baseline at 12, 18, and 24 months post-intervention. However, both intervention and control group units had significantly increased within-group rates at 24 months, 13.77/100 FTEs in the intervention group and 15.41/100 FTEs in the controls. Results did not change when controlling for employee age, gender, and unit block.

Rates of violence-related injuries

Rates of injury due to violence are compared over time within and between study groups in Table 3 and illustrated in Figure 3. There were no significant differences in injury rates between the intervention and control units at baseline or at 6, 12, or 18 months post-intervention. There were no statistically significant changes in injury rates over time in the intervention group. At 24 months, the risk for violence-related injury was lower on intervention units, compared to controls (IRR 0.37, 95% CI 0.17-0.83), where the rate was significantly higher than baseline (IRR 2.33, 95% CI 1.41-3.84). The rate of violence-related injury had decreased slightly, not significantly, in the intervention group from 3.24/100 FTEs at baseline to 2.81/100 FTEs (IRR 0.87, 95% CI 0.46-1.63) and had increased significantly in the control group from 3.43/100 fulltime equivalents (FTEs) to 8.09/100 FTEs. Results did not change when controlling for employee age, gender, and unit block.

Intervention strategies to reduce workplace violence

A total of 17 of the 21 intervention unit supervisors (81%) returned action plans to the walkthrough team. One year post-intervention, 16 of the 21 intervention units (76%) and 10 of the 20 control units (50%) completed the follow-up surveys. Table 4 provides examples of the types of violence reduction strategies implemented by the intervention and control units.

Based on the follow-up survey, all 16 of the responding intervention units had implemented violence prevention strategies, compared to 8 of the 10 responding control units. When asked in the survey to give reasons for not implementing any strategies, one acute care nursing control unit supervisor commented:

> "I have discussed workplace violence in my morning huddles and we have had open discussions but it is nothing structural."

A detailed evaluation of the intervention process will be reported elsewhere.

DISCUSSION

The aim of this study was to evaluate the impact of a data-driven intervention on hospital workplace violence by prospectively tracking population-based incidence rates of patient-to-worker events and injuries. Six months post-intervention, incident rate ratios of violent events were significantly lower on intervention units compared to controls. At the 24 month-

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follow up, the risk for violence-related injury was significantly lower on intervention units, compared to controls. While there were no statistically significant decreases in event and injury rates over time in the intervention group, that group had significantly lower risks for both events and injuries over time, compared to controls. These results suggest a positive effect of the intervention in that rates of violent events in the intervention group did not increase in the first 6 months post-intervention. By comparison, the control group rate for the same 6-month period increased sharply, with a significant group by time effect. The graphic illustration of rates of violent events over the full 5-year period (Figure 2) indicated a fairly stable fluctuation of rates between 7 and 10 incidents/100 FTEs in both study groups pre-intervention. In the first 12 months post-intervention, intervention group rates stayed within that same range, whereas rates in the control group spiked above 10/100 FTEs at both 6 and 12 months post-intervention. At 24 months, rates in both study groups reached their highest levels, and both rates were significantly higher than baseline. These results would suggest that the initial positive effects of the intervention were not maintained. However, at 24 months post-intervention, rates of violence-related injuries were significantly lower in the intervention group, compared to controls, suggesting that the intervention may have helped in reducing the severity of violent events in the intervention units. Of note, there were no statistically significant changes in injury rates in the intervention group over the entire 5-year study period, although violence-related injury rates increased in U.S. hospitals generally over the course of this study.[3]

The significance of our findings is attributed to the control group increasing in rates after the intervention while the treatment group maintained its pattern of variability. Data analyses accounted for variation within and between units within each group (intervention and control) at each six-month time interval over the 5-year study period. This decreases the likelihood that the significant group-by-time effects were the results of random rate fluctuations.

Previous workplace violence interventions reported an increase in violent events, rather than an anticipated decrease, which was attributed to heightened awareness of violence among study participants as a result of the intervention.[14,15,28] However, this does not seem to be the case in the current study, as the rate of events in the intervention group did not increase in the immediate 6 months post-intervention. Underreporting, a well-recognized phenomenon in studies of workplace violence[29,45] and adverse occupational outcomes generally,[46] had been examined in this study population pre-intervention. By comparing individual hospital workers' self-reports of violence via questionnaire and via the hospital system's electronic incident reports, researchers found an underreporting rate of 88%.[29] Pre-intervention, the rate of violence underreporting did not differ significantly between the intervention and control groups, and there was no evidence to suggest that these rates changed, going forward. If the intervention had resulted in an increased tendency to report among intervention group employees, rates of reported violent events would have increased, not decreased.

Previous research identified violence-related injury as the strongest factor associated with reporting of workplace violence events among hospital workers,[29] and these variables are likely highly correlated. Assuming similar reporting practices in both intervention and

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control groups, this suggests that intervention group staff were exposed to fewer violent events and injuries per 100 FTEs, while control group staff were exposed to more. As evidenced by the data, the rates of violent events were higher than the rates of injury, i.e., events are more common than injuries. Thus, studying events has greater statistical power. Clearly, events should serve as the early warning of risk for injuries, which underscores the importance of having a comprehensive reporting system. In light of the negative effects of even non-physical workplace violence for hospital worker well-being,[8,23] the results of this study suggest that the intervention methods presented may help to prevent Type II workplace violence in hospitals. The intervention may have also helped staff to become more aware of violence and increase their ability to de-escalate, thus avoiding more serious acts of violence.

The study design did not include any form of booster intervention, such as an additional site visit. The fact that significant group by time differences were evident 6 months post-intervention, but not at later time points, suggests that some sort of booster measure might enhance this intervention methodology. Examples of such boosters might be additional electronic workplace violence data reports to unit supervisors or electronic reminders from hospital management to implement the proposed action plan. However, boosters entail additional resources, and have not always been effective in occupational interventions.[47]

Project results speak to the benefit of bringing the issue of workplace violence to the unit level, providing each unit with its own rates and a structured summary of the incidents to which unit staff has been exposed. This may have motivated unit supervisors and staff to assume ownership and responsibility for the problem.[40] The presentation of unit-level data compared to corresponding data for the entire hospital system was an important eye-opener for unit supervisors; they saw clearly that their workers were at increased risk for violence and related injury, compared to all other hospital workers. Similar procedures were used in earlier quality improvement studies.[33-36] However, none of those studies were randomized, controlled interventions.

With stakeholder involvement and support, and the use of a worksite checklist,[42] unit supervisors and staff were able to develop and implement strategies based on their own unit's violence data and characteristics. Selected strategies and the resultant action plans differed widely across the intervention units, reflecting the specific nature and circumstances of the workplace violence on each unit. However, 4 of the 21 intervention units never completed the action plan form, and 5 intervention units did not respond to the follow-up survey; 2 units did not complete either. It is not known whether the non-responding units implemented violence prevention measures or not. However, all of the intervention units that did respond to the follow-up survey reported having implemented at least one strategy.

Previous attempts at violence reduction in hospitals have been workplace-specific[15,28] and did not result in significant violence reduction. The elements of this project represent a standardized approach to workplace violence reporting, risk and hazard appraisal, and intervention. The methods used in this study represent a shift from case-based to population-based surveillance, applying epidemiological analysis to a comprehensive reporting system. Epidemiological risk analysis can then be translated into fact-based prevention practices that

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can be prospectively evaluated for effectiveness via the comprehensive database. This approach provides an evidence-based template for the entire workplace violence risk surveillance, reduction and evaluation process. It represents an organizational and systems perspective to workplace violence that views violence as related to work processes and conditions, rather than merely the result of interpersonal conflict.[48] Importantly, this approach also gives individual units the flexibility to use their own data to drive the violence prevention process. Thus, while the intervention framework is standardized, the actual intervention does not follow a "one size fits all" approach, which has been considered unrealistic in workplace violence prevention.[49]

Strengths and limitations

A major strength of this study is the randomized design and the scale of the study, which encompassed over 2,800 employees in 41 work units across 7 hospitals. The study also made use of previously developed, evidence-based elements, including the Hazard Risk Matrix,[41] the worksite walkthrough[26,42] and the worksite checklist for identifying risk factors[42] and preventive strategies[43] for workplace violence. Utilizing a participatory action research approach, the project included hospital system stakeholders, representing both management and labor, in all aspects of the project. This included development and design of the worksite visit ("walkthrough"), which was designed to be brief and as non-disruptive as possible. None of the 21 visits took longer than 45 minutes, and with one exception, visits were held with the unit supervisor and only one or two other members of the unit staff (the exception was a psychiatric unit where supervisors scheduled the visit so that a maximum number of staff could attend). The rationale behind this design was to create a process that worked well enough with the clinical reality of most hospital units, thereby increasing the likelihood of sustaining the practice even after the project's conclusion. Importantly, the walkthrough team provided the data, but played no role in determining the specific prevention measures that were implemented on the intervention units. This, too was a deliberate aspect of the study design, with the intention being to implement a method that could be sustainable over time by placing responsibility for violence prevention with the units themselves.

A number of limitations should also be noted. Although the study was conducted across multiple sites, it took place within a single hospital system in a single geographic area of the Midwestern United States. Thus, some of the results may not be generalizable to other hospital systems. Secondly, although the intervention was designed to be as non-disruptive as possible, the fact remains that hospitals are busy places. One of the biggest challenges of project implementation was scheduling the worksite visits with unit supervisors. Nevertheless, the 21 visits were conducted over a 6-week period, suggesting that the practice holds promise for replication and sustainability over time. However, none of the walkthroughs in this study were conducted during night time hours and suggestions for violence prevention measures may therefore not have included the viewpoints of unit staff working night shifts. Third, contamination between intervention and control sites cannot be ruled out, since several of the intervention and control units were located in the same hospitals. However, contamination would suggest a "rub off" positive effect of the intervention between intervention and control sites. Results suggest that this was not the case, as we found a significant increase in rates of violent events in the control group, with a

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significant relative decreased risk in the intervention units. Fourth, as in any action research, this project was not conducted in a laboratory and the possible effects of outside influences cannot be ruled out. For example, there were organizational changes that occurred over the course of this study, including a change in hospital system ownership. However, these changes affected both intervention and control sites equally. Fifth, follow-up with control site supervisors revealed that at least half of the control units did implement some form of violence prevention strategy during the study period. One would expect those strategies to be reflected in a decrease in rates of violence, rather than the observed increase. The fact that no corresponding decrease in the rates of violent events was seen suggests that control group intervention strategies were therefore not effective enough to protect units from an increase in rates of events. Control group units did not receive data reports of violence incidents and injuries, nor did they receive a worksite visit from researchers and hospital administrators. This offers further support of the positive effect of the data-driven, structured walkthrough implemented in the intervention work units. As reported, the lack of structure was, in fact, mentioned by one of the control unit supervisors in a comment in the follow-up survey.

Conclusion

This study is the first to demonstrate the possible positive effects over time of a randomized controlled intervention in protecting against an increase in Type II violence, a major occupational health and safety challenge in healthcare settings. In a time period marked by a general increase in workplace violence-related injury in hospitals,[3] the possible protective effect of our intervention is noteworthy. While we did not see statistically significant decreases in event and injury rates in the intervention group, we did find significantly lower risks for both events and injuries in that group over time, compared to controls. The statistical significance of our findings is attributed to the control group increasing in rates after the intervention compared to the intervention group, where rates were maintained. This protective effect on violence was demonstrated at 6 months, but not at the subsequent assessments. In contrast, the program found similar beneficial effects on violence-related injury 24 months post-intervention, i.e., a sharp increase in the control group rate not seen in the intervention group. This suggests the need for additional measures to booster the intervention. Future studies utilizing this methodology should strive to evaluate whether effects of the intervention can be maintained via such booster methods. Nevertheless, violence injury rates differed significantly between study groups 24 months post intervention, suggesting that the intervention may have had a protective effect regarding incident severity. The delayed effect on injury rates suggests the need to better understand the nature of the Type II events that result in worker injuries. Results of this study fill a high priority gap in hospital workplace violence prevention by establishing evidence-based methods for translating violence surveillance data into fact-based risk analysis and prevention. The methodology presented here for workplace violence monitoring, risk assessment and intervention could be standardized and translated to hospital systems nationwide to improve worker health and safety.

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authors and does not necessarily represent the official views of CDC-NIOSH. This paper is dedicated to the memory of our esteemed colleague, Joel Ager, PhD, who played a major role in the design and analysis of this project.

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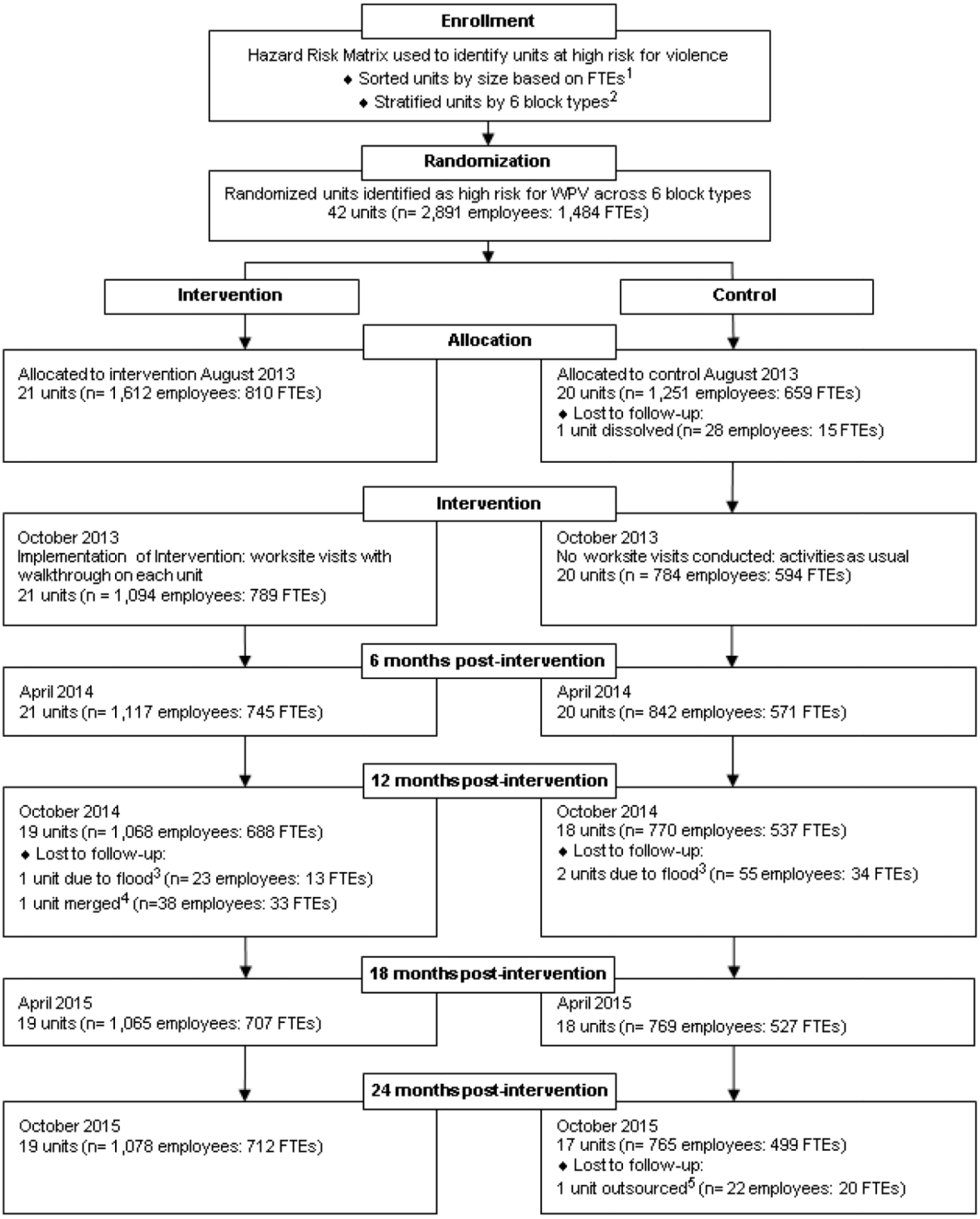

Figure 1.

Flow diagram of enrollment, randomization and follow-up of study participants (units)

[1]FTEs = Full-Time Equivalents

[2]6 block types were acute care nursing, intensive care nursing, emergency department, psychiatry, security, and surgery

[3]3 units (1 intervention, 2 control) were closed due to the flooding of one hospital, August 2014

[4]One unit merged with a non-study unit, and was excluded from further analyses

[5]One unit was dissolved due to outsourcing of employees

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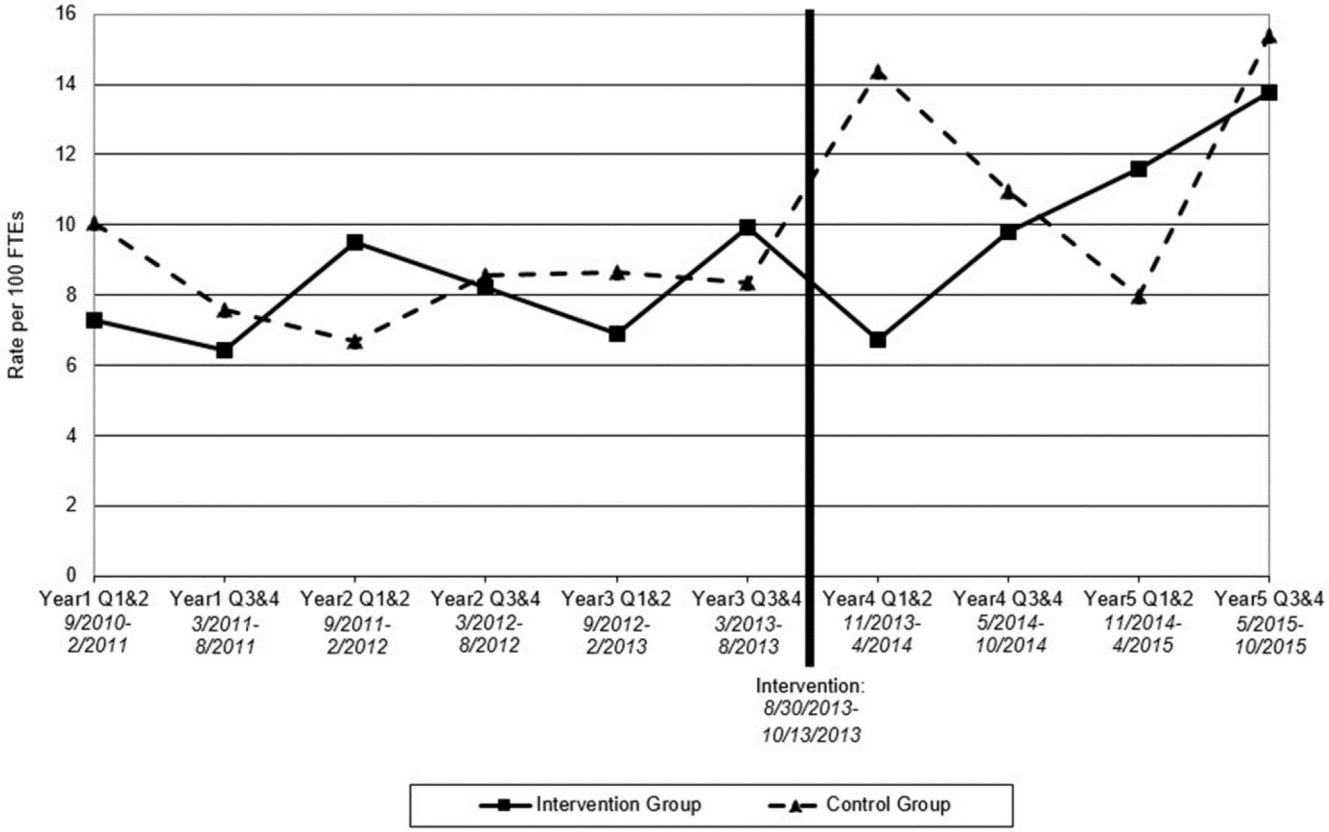

Figure 2.

Rates of violent events per 6-month intervals, Intervention and Control units, 36 months pre and 24 months post-intervention.

Intervention period: August 30, 2014 -October 13, 2014

Rates = number of incidents/100 full-time equivalents (FTEs)

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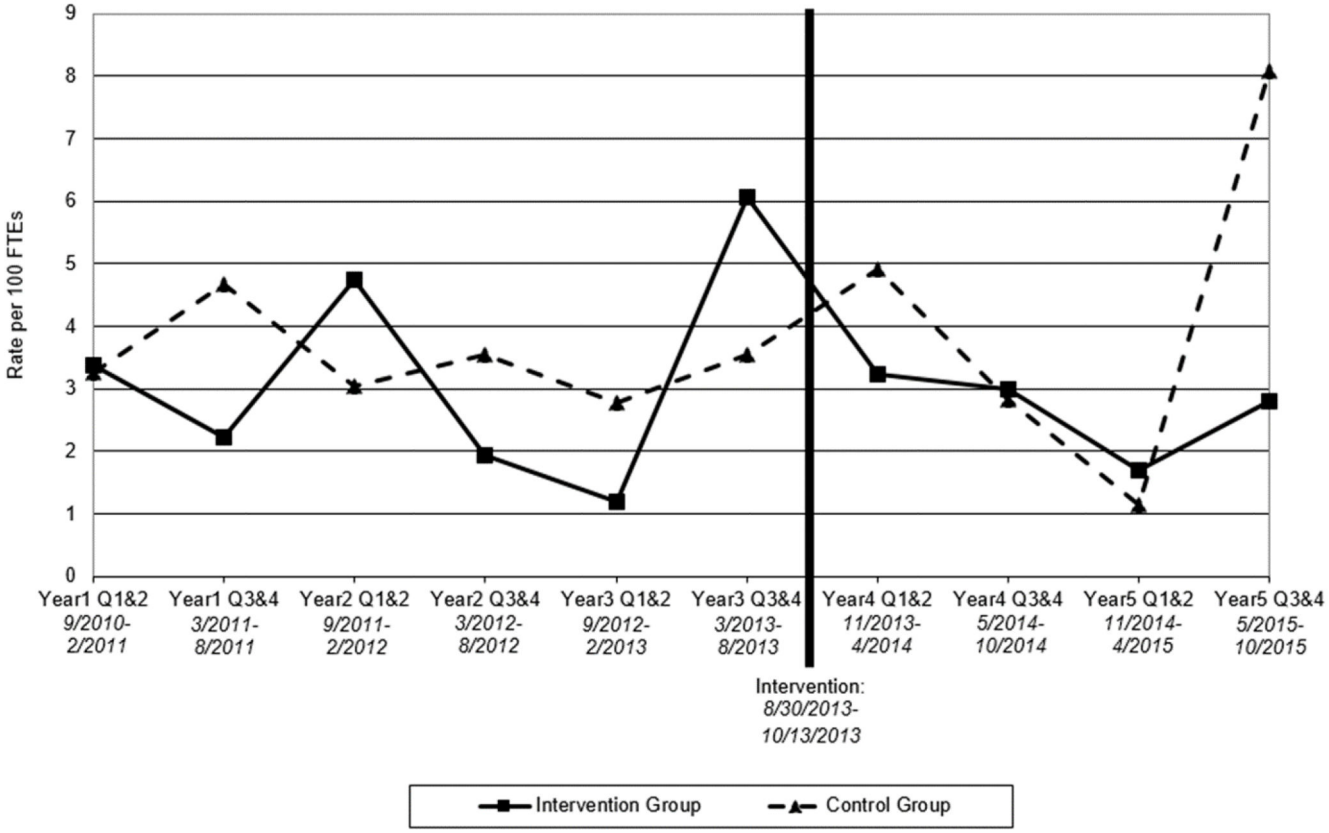

Figure 3.

Rates of violence-related injury per 6-month intervals, Intervention and Control units, 36 months pre and 24 months post-intervention.

Intervention period: August 30, 2014 -October 13, 2014

Rates = number of incidents/100 full-time equivalents (FTEs)

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Table 1

Demographic and work-related characteristics of hospital workers in the 41 study units at baseline, Intervention vs. Control

	All units combined (n=2,863)	Intervention units (n=1,612)	Control units (n=1,251)	X^2 (*p*-value)
	N (%)	N (%)	N (%)	
Gender				11.91 (<.001)
Male	611 (21.3)	306 (19.0)	305 (24.4)	
Female	2,252 (78.7)	1,306 (81.0)	946 (75.6)	
Age group				10.98 (<.05)
≤ 29 years	726 (25.4)	431 (26.7)	295 (23.6)	
30-39 years	750 (26.2)	443 (27.5)	307 (24.5)	
40-49 years	657 (22.9)	356 (22.1)	301 (27.8)	
≥ 50 years	730 (25.5)	382 (23.7)	348 (27.8)	
Job Category				48.14 (<.001)
Allied health professional	75 (2.6)	60 (3.7)	15 (1.2)	
Clerical	35 (1.2)	15 (0.9)	20 (1.6)	
Manager/Admin. professional	139 (4.9)	70 (4.3)	69 (5.5)	
Mental health technician	79 (2.8)	43 (2.7)	36 (2.9)	
Nursing	1,735 (60.6)	981 (60.9)	754 (60.3)	
Other technicians	168 (5.9)	81 (5.0)	87 (7.0)	
Patient care assoc./Med. assistant	334 (1.7)	192 (11.9)	142 (11.4)	
Security	188 (6.6)	94 (5.8)	94 (7.5)	
Surgical technicians	23 (0.8)	23 (1.4)	0 (0.0)	
Unit clerk	87 (3.0)	53 (3.3)	34 (2.7)	
Unit Block				53.56 (<.001)
Acute Care Nursing	1,154 (40.3)	707 (43.9)	447 (35.7)	
Intensive Care (ICU) Nursing	276 (9.6)	109 (6.8)	167 (13.3)	
Emergency Department (ED)	726 (25.4)	389 (24.1)	337 (26.9)	
Psychiatry	234 (8.2)	132 (8.2)	102 (8.2)	
Security	197 (6.9)	100 (6.2)	97 (7.8)	
Surgery	276 (9.6)	175 (10.9)	101 (8.1)	

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Table 2

Type II workplace violence events, incidence rates, and incidence rate ratios (IRRs) over time, Intervention vs. Control group (n=41 study units)

	Intervention Group		IRR within group (compared to baseline)	Control Group		IRR within group (compared to baseline)	IRR Intervention/ Control
	Events (n)	**Rate[a]**	**IRR (95% CI)**	**Events (n)**	**Rate[a]**	**IRR (95% CI)**	**IRR (95% CI)**
Baseline (3-year average)[b]	196	8.05		165	8.32		
6 months post-intervention	25	6.71	0.83 (0.56, 1.24)	41	14.36	**1.72 (1.25, 2.37)[c]**	**0.48 (0.29, 0.80)[c]**
12-months post-intervention	36	9.81	1.21 (0.80, 1.83)	31	10.96	1.32 (0.88, 1.98)	0.92 (0.52 , 1.64
18-months post-intervention	41	11.60	1.44 (0.97, 2.14)	21	7.97	0.96 (0.61, 1.49)	1.51 (0.83, 2.73)
24-months post-intervention	49	13.77	**1.71 (1.20, 2.43)[c]**	40	15.41	**1.85 (1.27, 2.71)[c]**	0.92 (0.55, 1.55)

[a]Rate = number of incidents/100 Full-time equivalents (FTEs)/year annualized;

[b]Analyses accounted for variability in group rates at each 6-month interval within the 3-year pre-intervention period (September 2010-August 2013)

[c]p<.01

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Table 3

Type II workplace violence-related injuries[a], incidence rates, and incidence rate ratios (IRRs) over time, Intervention vs. Control group (n=41 study units)

	Intervention Group		IRR within group (compared to baseline)	Control Group		IRR within group (compared to baseline)	IRR Intervention/ Control
	Injuries (n)	Rate[b]	IRR (95% CI)	Injuries (n)	Rate[b]	IRR (95% CI)	IRR (95% CI)
Baseline (3-year average)[c]	79	3.24		69	3.43		
6 months post-intervention	12	3.22	0.99 (0.55, 1.78)	14	4.90	1.41 (0.81, 2.46)	0.70 (0.31, 1.58)
12-months post-intervention	11	3.00	0.92 (0.49, 1.73)	8	2.83	0.81 (0.39, 1.70)	1.13 (0.43 , 2.98)
18-months post-intervention	6	1.70	0.52 (0.23, 1.21)	3	1.14	0.33 (0.10, 1.05)	1.60 (0.38, 6.69)
24-months post-intervention	10	2.81	0.87 (0.46, 1.63)	21	8.09	**2.33 (1.41, 3.84)**[d]	**0.37 (0.17, 0.83)**[e]

[a]Type II violence-related injuries are a subset of the total number of Type II events

[b]Rate = number of injuries/100 Full-time equivalents (FTEs)/year annualized

[c]Analyses accounted for variability in group rates at each 6-month interval within the 3-year pre-intervention period (September 2010-August 2013)

[d]$p<.01$

[e]$p<.05$

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Table 4

Examples of implemented violence reduction strategies across study units

Type of Unit	Study Group	Environmental Strategies	Administrative Strategies	Behavioral Strategies
Acute Care Nursing	Intervention	Attempt made to lock unit during off shifts rejected by physicians and administration, though supported by security.	Worked with psychiatry for timely response to consults and intervention, e.g. medication, inpatient psych admission; security rounds increased in frequency and intensity; continued timely response to our calls from security.	Working with administration to implement de-escalation training with staff on [unit] as well as house-wide; patient care services attentive.
Acute Care Nursing	Intervention	Panic alarms installed on the nursing units.		Behavioral management classes for the staff and established that the classes are to be done annually.
Emergency Department	Intervention	Requested increased lighting in the parking lots surrounding the ED.	Change in staffing to balance schedules better.	Mandatory teambuilding classes for the ED and offered active shooter classes, customer service classes.
Acute Care Nursing	Intervention		Staff will not go home at 3am or so just to be safe.	Staff educated to stay calm when the patient got aggressive and call for help if patient threatens.
ICU Nursing	Intervention	More frequent rounding by security, re-established the panic button under the front desk.	Putting staff through a video and verbal presentation by our security police called “Active Shooter” in next few months.	
Security	Intervention	Security assessments of the departments, finding short-comings and making recommendations, partner with hospital safety.	Monthly meetings with hospital safety, occupational health and security regarding workplace violence.	
Acute Care Nursing	Control	Changed beds so all have alarms. Ensured supplies available to use gait belts.	We added a PCA [patient care associate] to come in at 10am 4 days/week to assist during heavy times. Added clinical coordinator to unit to assist with high activity.	Education in Net Learning and system wide values training. Review all patient incidents with involved parties and discuss in meetings.
Psychiatry	Control	Changes to the location of the cameras that monitor the patients have been implemented. Also, some of the cameras were updated to newer ones that have better visual capabilities.	We have implemented several Safety Monitoring policies including safety protocols for non-[hospital system] personnel entering the unit.	