

# Visitor Behaviors Can Influence the Risk of Patient Harm:

An Analysis of Patient Safety Reports From 92 Hospitals

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DOI: 10.33940/data/2022.6.7

## Abstract

**Background:** Previous research has shown that visitors can decrease the risk of patient harm; however, the potential to increase the risk of patient harm has been understudied.

**Methods:** We queried the Pennsylvania Patient Safety Reporting System database to identify event reports that described visitor behaviors contributing to either a decreased or increased risk of patient harm. Event reports from January 1 to June 30, 2019, were searched for keywords and reviewed for inclusion criteria. Event reports were manually coded to identify visitor influence on risk of patient harm (e.g., increase or decrease), visitor behavior, and event type.

**Results:** A total of 427 event reports were analyzed and we identified five categories of visitor behavior that influenced patient safety by either decreasing or increasing the risk of patient harm. We found that 63.7% (272 of 427) of event reports described a visitor behavior that decreased the risk of patient harm and the remaining 36.3% (155 of 427) of reports described behavior that increased the risk of harm. There was a greater variety of visitor behaviors that contributed to an increased risk of patient harm, as opposed to a decreased risk of harm. The visitor behavior most frequently associated with a decreased risk of patient harm was

communicating with staff (91.2%, 248 of 272); for example, to inform staff of deterioration of a patient's condition. The visitor behavior most frequently associated with an increased risk of patient harm was moving a patient (63.2%, 98 of 155). Across the 427 event reports, we found that visitor behavior was associated with seven event types; the falls event type (61.6%, 263 of 427) and medication-related event type (14.8%, 63 of 427) occurred most frequently.

**Conclusion:** The current study provides insight into which visitor behaviors are contributing to a decreased risk of patient harm and adds to the literature by identifying behaviors that can increase the risk of patient harm, across multiple event types. **Table 6** and **Table 7** outline potential safety strategies that staff and facilities may consider using to target visitor behavior. As outlined in **Table 6**, the use of warning and instructional signage can be a relatively low-effort and effective strategy to influence visitor behavior and address multiple behavior categories and event types.

**Keywords:** *visitors, family, patient safety, hospital, behavior, intervention, risk mitigation, signage, warning sign, instructional sign*

## Introduction

Visitors to hospitals can influence patient safety through behaviors that either increase or decrease the risk of patient harm. Previous research has demonstrated the positive influence of visitors on patient outcomes.<sup>1-16</sup> For example, studies have found that visitors can successfully participate in patient safety interventions, such as fall prevention<sup>15,16</sup> and rapid response activation.<sup>9</sup> The potential for visitors to contribute to an increased risk of patient harm is less understood. A limited number of prior studies found that visitors can cause staff interruptions,<sup>17-21</sup> which could increase the risk of patient harm. Most of these studies did not examine an event type related to these interruptions and the few that did focused on medication errors.<sup>20,21</sup> Despite the insights provided by previous studies, further research is needed to better understand how visitor behaviors may be associated with a range of event types and the potential to contribute to an increased risk of patient harm.

We observed event reports in the Pennsylvania Patient Safety Reporting System (PA-PSRS)<sup>a</sup> database that described visitor behavior directly affecting patient safety across different types of events and, in some instances, contributing to an increased risk of patient harm. Thus, we explored event reports in PA-PSRS that described visitor behaviors that contributed

<sup>a</sup>PA-PSRS is a secure, web-based system through which Pennsylvania hospitals, ambulatory surgical facilities, abortion facilities, and birthing centers submit reports of patient safety-related incidents and serious events in accordance with mandatory reporting laws outlined in the Medical Care Availability and Reduction of Error (MCARE) Act (Act 13 of 2002).<sup>42</sup> All reports submitted through PA-PSRS are confidential and no information about individual facilities or providers is made public.

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Disclosure: The authors declare that they have no relevant or material financial interests.

to either an increased or decreased risk of patient harm. Our study will expand upon existing literature by comparing and exploring variable relations across five categories of visitor behavior and seven event types. Additionally, we propose potential safety strategies to influence multiple visitor behaviors and event types. Overall, an understanding of the relationship between visitor behaviors and patient safety can be used to inform policies and design of interventions that are beneficial to both patients and staff.

## Methods

### Data Query

Data for this study were collected from event reports within the PA-PSRS database. PA-PSRS has been active since May 2004 and contains over 4 million event reports, making it one of the largest patient safety databases in the world. Event reports include responses to many structured fields (e.g., event date, patient age, patient sex, care area, facility type), as well as several free-text narrative fields that allow the reporter to describe the details of the event in their own words. The quantity and quality of the information in the free-text fields varies from one report to another and does not include access to the patient's medical record.

We queried the PA-PSRS acute care database for events that occurred in Pennsylvania hospitals between January 1 and June 30, 2019. We chose this date range to capture events that occurred before visitor restrictions were implemented due to the COVID-19 pandemic<sup>22</sup> and we limited the time frame to six months to allow for a timely review and analysis. Only event reports identifying patients age 18 years and older were included and we limited the facility types to include only acute care hospitals and five care area groups<sup>b</sup> (intensive care unit, intermediate unit, medical-surgical unit, rehabilitation unit, and specialty unit). Finally, this query included a search of the free-text narrative fields for keywords by applying the following two approaches:

Approach 1: A traditional keyword search was applied to identify

reports that included one or more keywords that represented a visitor<sup>c</sup> and one or more keywords that represented a behavior.<sup>d</sup>

Approach 2: Regular expression (regex) pattern programming was applied to identify reports that included "patient" or "pt" within 15 characters of one or more keywords that represented a visitor.

This query produced a total of 1,944 event reports that were then manually reviewed to identify reports that described a visitor engaging in a behavior that influenced the risk of patient harm. We defined "visitor" as any individual who came to visit a patient and who was not designated by the facility as someone responsible for the patient's care (e.g., staff, volunteer). Event reports were included regardless of whether the visitor behavior was accidental (e.g., knocking over equipment) or deliberate (e.g., turning off an infusion pump). A visitor's prior knowledge of the appropriateness of their behavior was not considered when determining relevance.

Event reports were excluded if they did not provide sufficient information to determine whether a visitor engaged in behavior that influenced the risk of patient harm. We also excluded event reports that described a visitor providing a patient with an illicit substance, as these are instances where a visitor engaged in unlawful behavior, making them unique cases that are outside the scope of this research topic. Additionally, visitor involvement in patients' possession and use of illicit substances was recently examined in a separate study of PA-PSRS event reports.<sup>23</sup> Based on this manual review, we identified a total of 427 relevant event reports that were included in the subsequent analysis.

### Variables Coded

Based on the event reports, we analyzed two sets of variables. The first set was coded by the event reporter and included patient demographics (i.e., age and sex), event date, facility identifier, and care area. The second set of variables was manually

coded and included visitor influence on risk of patient harm, visitor behavior, event type, and visitor demographics.

### Visitor Influence on Risk of Patient Harm.

In each event report, visitor behavior was coded as either increasing or decreasing risk of patient harm. Increased risk of patient harm was defined as an instance where the visitor, regardless of their intentions, either injured the patient or created an elevated risk of injury. For example, if a visitor was assisting a patient with ambulating to the bathroom and the patient fell, this was categorized as a visitor contributing to an increased risk of patient harm.

Decreased risk of patient harm was defined as any instance where the patient experienced an adverse event, a change in condition, or an elevated risk of harm independent of visitor behavior, but the visitor reacted and reduced the potential severity of harm. For example, if hospital staff were administering the wrong medication to a patient and the visitor alerted them to the problem, then this was categorized as a visitor contributing to a decreased risk of patient harm.

**Visitor Behavior.** Visitor behavior consisted of five categories and each included several subcategories, which are defined in **Table 1**. Each event report was coded as having only one behavior category and one behavior subcategory. For example, if a visitor administered a medication from home to the patient and then alerted staff that the home medication was given, we coded the behavior as *provided or removed items* and the subcategory as *provided*.

**Event Type.** Event type was coded to identify the patient's experience or outcome. See **Table 2** for definitions of the seven mutually exclusive categories of event type.

**Visitor Demographics.** When possible, visitor gender and relationship to the patient were coded. These were inferred from descriptors given in the free-text fields of the event report. For example, if the event details mentioned that the visitor was the patient's wife, gender would be coded as *female* and relationship to the patient would be categorized as *spouse*.

<sup>b</sup>Within PA-PSRS, the event reporter chooses among 179 care areas to indicate the location where an event occurred. To simplify our analysis, we sorted each of the care areas into 23 higher-level care area groups.

<sup>c</sup>The following keywords were used to identify reports involving a visitor: visitor, daughter, son, parent, mother, father, mom, dad, friend, uncle, aunt, grandpa, grandma, family, husband, wife, spouse, niece, nephew. Based on pre-study pilot testing of >25 keywords in PA-PSRS reports, we strategically selected these 19 keywords to reduce the false positive rate.

<sup>d</sup>The following keywords were used to identify reports involving a behavior: "visit." (with a space following the word), visiting, assisted, help, yell, holding, laid, laying, sitting, fall, ambulate, disconnect, witness, OOB, provided, educate. Based on pre-study pilot testing of >30 keywords in PA-PSRS reports, we strategically selected these 16 keywords to reduce the false positive rate.

**Table 1.** Categories and Definitions of Visitor Behavior That Influenced the Risk of Patient Harm

Visitor Behavior	Subcategories of Visitor Behavior	Definition
Communicated with staff	Alerted staff and/or provided additional information	Visitor interacted with staff to bring a patient safety event to their attention or to provide additional details about an event.
	Distracted staff	Visitor interacted with staff, resulting in staff diverting their attention away from their patient care routine.
Moved or physically stabilized patient	Ambulated	Visitor assisted patient in walking or moving about.
	Increased physical stability	Visitor helped patient regain balance or lowered the patient to the floor or other horizontal surface.
	Transported	Visitor escorted patient from one place to another within the hospital.
	Repositioned	Visitor adjusted the patient's position.
Provided or removed items	Provided	Visitor gave a potentially harmful item to a patient.
	Removed	Visitor took away a potentially harmful item from a patient.
Manipulated equipment or a device	Moved or repositioned	Visitor changed the placement of equipment or a device that was being used for patient care.
	Turned on or off	Visitor powered on or off equipment or a device that was being used for patient care.
	Connected or disconnected	Visitor attached or detached equipment or a device that was being used for patient care.
Other	N/A	Visitor behavior that was not aligned with the aforementioned categories.

**Note:** Each of the 427 event reports was coded as having only one behavior category and one behavior subcategory. Note that details for some of the behaviors will be identified and defined in the **Results** section.

**Table 2.** Categories and Definitions of Event Type That Identify Patient Experience or Outcome

Event Type	Definition
Fall	Patient experienced an unplanned descent to the floor or other horizontal surface, such as a chair or bed, or such an event was prevented.
Medication-related	Patient was impacted by a medication error (e.g., wrong medication, wrong route), a medication error was prevented, or a patient was given a home or over-the-counter medication while in the hospital.
Integrity of care	Patient experienced an interruption of care (e.g., intravenous or nasogastric tube dislodged, intravenous infiltration), delayed care (e.g., delayed response to call bell), or other care or process-related event (e.g., tourniquet left on patient's arm).
Change in condition	Patient experienced a decline in mental or physical functioning (e.g., new or worsening symptoms, loss of consciousness, slurred speech).
Skin-related	Patient experienced a skin-related injury (e.g., pressure injury, skin tear, burn).
Dietary/nutrition	Food given to or removed from a patient was not consistent with their prescribed diet, was a known allergen, or was otherwise potentially harmful to the patient.
Other	An event type that was not aligned with one of the aforementioned categories.

**Note:** Each of the 427 event reports was coded as having only one event type. Note that details for some of the event types will be identified and defined in the **Results** section.

**Visitors can prevent patient safety events.**

In our study, we identified instances where visitor behaviors prevented the following events from occurring:

- Falls
- Administration of incorrect medication
- Allergic reactions

## Data Analysis

We performed a descriptive data analysis to identify patterns in patient and visitor demographics, and the frequency with which visitor behavior resulted in an increased or decreased risk of patient harm. We also examined the relationship between each visitor behavior and event type, which provides insights among various combinations of variables.

## Results

### Demographics

The analysis included a total of 427 event reports from 92 hospitals. Across all event reports, 49.2% (210 of 427) involved female patients and 50.8% (217 of 427) involved male patients. The average patient age was 66.2 years with a median of 70 years (range = 18–100 years; 25<sup>th</sup> percentile = 56 years; 75<sup>th</sup> percentile = 80 years). The gender of the visitor was inferred in 296 of the reports, with the majority involving a female visitor (70.3%, 208 of 296). The relationship of the visitor to the patient was described in 292 of the reports. In these reports, most involved a patient's spouse or partner (55.1%, 161 of 292), or adult child (35.3%, 103 of 292). Patient and visitor demographics were similarly distributed across influence on risk of patient harm, categories of visitor behavior, and event types.

### Visitor Behavior and Influence on Risk of Patient Harm

**Figure 1** shows that 63.7% (272 of 427) of event reports described a visitor behavior that decreased the risk of patient harm and the remaining 36.3% (155 of 427) of reports described behavior that increased the risk of harm. **Table 3** reports the relationship between visitor behaviors and their influence on the risk of patient harm. Across all five categories of visitor behavior, four were most frequently associated with an increased risk of harm. More specifically, visitor behavior was associated with an increased risk of patient harm in more than 81% of the events in each of the following four categories: *moved or physically stabilized patient* (81.7%, 98 of 120); *provided or removed items* (94.6%, 35 of 37); *manipulated equipment or a device* (100%, 15 of 15); and *other* (100%, 6 of 6). This finding reveals that a range of visitor behaviors can result in an increased risk of harm. In contrast, *communicated with staff* was the only category of visitor behavior that was more frequently associated with a decreased risk of patient harm (99.6%, 248 of 249) than an increased risk. In all except one of the 249 reports in this

category, visitor behavior decreased the risk of patient harm by alerting staff about a patient fall or change in condition, or by providing staff with important information regarding patient care.

**Table 3** includes information about sub-categories of visitor behavior and their relationship with the risk of patient harm. We further analyzed two of the visitor behaviors with the greatest proportion of events associated with an increased risk of patient harm: *provided or removed items*, and *manipulated equipment or a device*. Additional analysis of the event descriptions revealed that in 82.9% (29 of 35) of reports that described a visitor increasing risk of harm by providing items to a patient, a home or over-the-counter medication was provided. Additionally, the equipment or devices most frequently manipulated by visitors were bed or chair alarms (26.7%, 4 of 15) and intravenous (IV) catheters (20.0%, 3 of 15). The items provided or manipulated by visitors highlight topics that could be prioritized for intervention.

### Visitor Behavior and Risk of Patient Harm by Event Type

**Table 4** shows that across the seven event types, there was a greater variety of visitor behaviors that contributed to an increased risk of patient harm, as opposed to a decreased risk of harm. Across all 427 reports, the four most frequent event types were falls (61.6%, 263 of 427), medication-related (14.8%, 63 of 427), integrity of care (7.5%, 32 of 427), and change in condition (7.0%, 30 of 427). **Table 4** also shows that all seven event types were associated with a visitor behavior that decreased risk of patient harm, which was largely attributed to visitor communication with staff. In contrast, multiple categories of visitor behavior contributed to an increased risk of patient harm across the following five event types: falls, medication-related, integrity of care, skin-related, and dietary/nutrition. Collectively, those five event types and the increased risk of patient harm were largely associated with the following three visitor behaviors: *moved or physically stabilized patient*, *provided or removed items*, and *manipulated equipment or a device*. This finding suggests that healthcare facilities should develop interventions to target the three aforementioned categories of visitor behavior that increased risk of harm.

We further investigated the two most frequent event types, falls and medication-related, to gain further insight into the context of those events. Among the fall events associated with an increased risk

of harm, we found that visitors turned off the bed or chair alarm prior to the fall in 11.6% (11 of 95) of the events, indicating that alarm management is an opportunity for risk mitigation. The visitor behavior in seven of these 11 reports was coded as *moved or physically stabilized patient* because it was the behavior most acutely related to the event type. In 11 of the 30 (36.7%) medication-related events that involved a decreased risk of harm, a visitor alerted staff to an error in medication documentation or orders. For example, one of the event reports described a staff member arriving to administer insulin to the patient as ordered; however, the patient's family informed them that the patient did not have diabetes and had not received insulin in the past. An ordering error was confirmed and the insulin was not administered. These insights into falls and medication-related events highlight topics that can be targeted for intervention; specifically, encouraging visitors to contact staff when a patient needs assistance with ambulating, encouraging visitors not to turn bed or chair alarms off, and encouraging visitors to speak up regarding possible medication discrepancies.

## Discussion

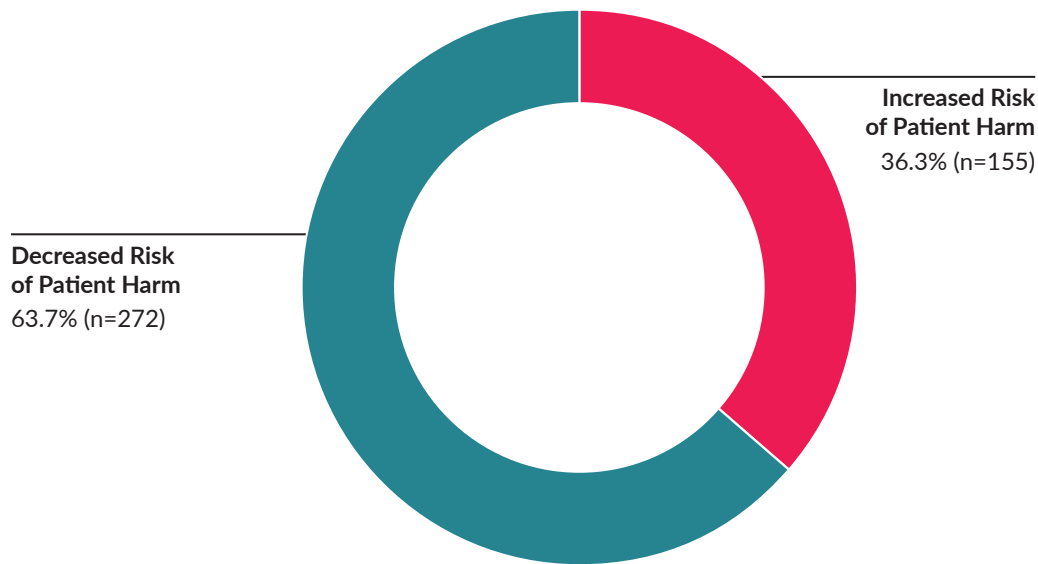
### Implications of Findings

Consistent with previous studies,<sup>1-16</sup> our results revealed that visitor behavior was frequently associated with a decreased risk of patient harm. For example, we found that visitor communication with staff was most frequently reported as decreasing risk of harm and was distributed across all seven event types. This suggests that, when designing an intervention to target visitor behavior, communication with staff should be prioritized.

The present study expanded upon previous research by identifying multiple visitor behaviors that contributed to an increased risk of patient harm across more than one event type. Specifically, six of the seven event types involved at least one behavior that was associated with an increased risk of patient harm. The three visitor behaviors that were most frequently associated with an increased risk of patient harm were: moving a patient, providing items to a patient, and manipulating equipment or a device. We recommend prioritizing these behaviors for intervention.

Finally, this study provides novel insight by analyzing the relationship between visitor behaviors, influence on risk of patient harm, and event types. Results from this

**Figure 1.** Influence of Visitor Behavior on Risk of Patient Harm, Across 427 PA-PSRS Event Reports



**Note:** Each of the 427 event reports was coded as either increasing or decreasing risk of patient harm (mutually exclusive).

**Table 3.** Frequency of Relationship Between Visitor Behavior and Influence on Risk of Patient Harm, Across 427 PA-PSRS Event Reports

Visitor Behavior	Subcategories of Visitor Behavior	Risk of Patient Harm		Total
		Decreased	Increased	
Communicated with staff	Alerted staff and/or provided additional information (e.g., regarding a fall, medication error, or change in condition)	248 (58.1%)	-	
	Distracted staff (e.g., communicated during care routine)	-	1 (0.2%)	
	<b>Total</b>	<b>248 (58.1%)</b>	<b>1 (0.2%)</b>	<b>249 (58.3%)</b>
Moved or physically stabilized patient	Ambulated (e.g., to or from the restroom, around the room)	-	95 (22.2%)	
	Increased physical stability (e.g., softened fall)	22 (5.2%)	-	
	Transported (e.g., moved patient via wheelchair)	-	2 (0.5%)	
	Repositioned	-	1 (0.2%)	
	<b>Total</b>	<b>22 (5.2%)</b>	<b>98 (23.0%)</b>	<b>120 (28.1%)</b>
Provided or removed items	Provided (e.g., food, drink, home medication)	-	35 (8.2%)	
	Removed (e.g., food)	2 (0.5%)	-	
	<b>Total</b>	<b>2 (0.5%)</b>	<b>35 (8.2%)</b>	<b>37 (8.7%)</b>
Manipulated equipment or a device	Moved or repositioned (e.g., bedpan, IV catheter, endotracheal tube, patient mobility sling, bed rail, feeding tube)	-	7 (1.6%)	
	Turned on or off (e.g., bed or chair alarm, medication infusion pump)	-	5 (1.2%)	
	Connected or disconnected (e.g., nasogastric tube, IV catheter)	-	3 (0.7%)	
	<b>Total</b>	<b>-</b>	<b>15 (3.5%)</b>	<b>15 (3.5%)</b>
Other	<b>Total</b>	<b>-</b>	<b>6 (1.4%)</b>	<b>6 (1.4%)</b>
<b>Grand Total</b>		<b>272 (63.7%)</b>	<b>155 (36.3%)</b>	<b>427 (100%)</b>

**Note:** Cells with a - represent a zero frequency per combination of categories. Each of the 427 event reports was coded as having either increased or decreased risk of patient harm (mutually exclusive) and having only one behavior. All percentages were calculated using a denominator of 427. Sum of percentages may not equal 100 due to rounding.

**Table 4.** Frequency of Relationship Between Visitor Behavior and Risk of Patient Harm by Event Type, Across 427 PA-PSRS Event Reports

Visitor Behavior and Risk of Patient Harm													
Event type	Communicated with staff		Moved or physically stabilized patient		Provided or removed items		Manipulated equipment or a device		Other		Total		Grand Total
	Decreased	Increased	Decreased	Increased	Decreased	Increased	Decreased	Increased	Decreased	Increased	Decreased	Increased	
Fall	139 (32.6%)	-	22 (5.2%)	95 (22.2%)	-	-	-	6 (1.4%)	-	1 (0.2%)	161 (37.7%)	102 (23.9%)	263 (61.6%)
Medication-related	30 (7.0%)	1 (0.2%)	-	-	-	29 (6.8%)	-	3 (0.7%)	-	-	30 (7.0%)	33 (7.7%)	63 (14.8%)
Integrity of care	28 (6.6%)	-	-	-	-	-	-	4 (0.9%)	-	-	28 (6.6%)	4 (0.9%)	32 (7.5%)
Change in condition	30 (7.0%)	-	-	-	-	-	-	-	-	-	30 (7.0%)	-	30 (7.0%)
Skin-related	14 (3.3%)	-	-	2 (0.5%)	-	2 (0.5%)	-	2 (0.5%)	-	4 (0.9%)	14 (3.3%)	10 (2.3%)	24 (5.6%)
Dietary/nutrition	1 (0.2%)	-	-	-	2 (0.5%)	4 (0.9%)	-	-	-	-	3 (0.7%)	4 (0.9%)	7 (1.6%)
Other	6 (1.4%)	-	-	1 (0.2%)	-	-	-	-	-	1 (0.2%)	6 (1.4%)	2 (0.5%)	8 (1.9%)
<b>Total</b>	<b>248 (58.1%)</b>	<b>1 (0.2%)</b>	<b>22 (5.2%)</b>	<b>98 (23.0%)</b>	<b>2 (0.5%)</b>	<b>35 (8.2%)</b>	<b>-</b>	<b>15 (3.5%)</b>	<b>-</b>	<b>6 (1.4%)</b>	<b>272 (63.7%)</b>	<b>155 (36.3%)</b>	<b>427 (100%)</b>

**Note:** Cells with a - represent a zero frequency per combination of categories. Each of the 427 event reports was coded as having either increased or decreased risk of patient harm (mutually exclusive), having only one behavior, and one event type. All percentages were calculated using a denominator of 427. Sum of percentages may not equal 100 due to rounding.

study showed that four of the five visitor behaviors were associated with the falls event type. When the event type fall was associated with an increased risk of patient harm, this almost always was the result of a visitor moving a patient or manipulating equipment or a device. Medication-related events that increased risk of patient harm were almost all the result of visitors providing medication to a patient. These relationships among variables can be leveraged to inform the choice and design of interventions to target falls and medication-related events. For example, interventions aimed toward preventing falls should prioritize deterring visitors from moving patients (e.g., helping them walk to or from the bathroom) and should encourage visitors to communicate with staff by asking for assistance or informing staff of a fall. Medication-related interventions should focus on discouraging visitors from providing patients with medication and encouraging visitors to speak up regarding medication discrepancies. **Table 5** provides a list of visitor behaviors that should be either encouraged or discouraged.

### Potential Safety Strategies

We believe most visitors who come to the hospital intend to be helpful and contribute to the well-being of patients; therefore, we recommend that hospitals use strategies to guide visitors toward behaviors that will decrease the risk of patient harm.

**Table 6** lists potential safety strategies, corresponding visitor behaviors, and associated event types identified in our study. In reviewing the literature, we were able to identify a limited number of strategies<sup>15,20,24</sup> and, among those strategies, we believe that only the following two could be used to target all five categories of visitor behavior and all seven event types: 1) educational programs for visitors<sup>15</sup> and 2) warning and instructional signage for visitors.<sup>20</sup> In our opinion, developing educational programs to target visitor behavior could be challenging because visitors often have unpredictable schedules and vary in life experience, education level, depth of medical knowledge, understanding of patient needs, and relationship with the patient (i.e., familiarity, feelings of obligation or expected caretaking, and history). Therefore, we believe that developing and displaying warning and instructional signage may be preferred because this strategy can target multiple types of visitors and many visitor behaviors and event types, and can be designed and implemented relatively quickly.

### Design Recommendations for Effective Signage

For warning and instructional signage to be effective, it must be carefully designed to increase reader interpretation and compliance with instructions. There is a robust body of evidence that informs the design of warning signs<sup>26-32,35-40</sup> and we believe this evidence can be generalized to signs that guide visitor behavior. We identified several design characteristics that can be used to increase sign effectiveness.

To be most effective, a sign must attract attention and convey knowledge.<sup>26</sup> Design characteristics that support these goals are described in **Table 7**. Sign effectiveness can be enhanced by strategically using fonts, colors,<sup>26,28</sup> and pictures<sup>30</sup> to attract attention and increase comprehension, placing them in patient rooms as opposed to in the hallways, and making them as specific as possible. Additionally, when developing signs, staff should also consider individuals with visual impairment,<sup>26</sup> low literacy or education level,<sup>33</sup> and language or cultural barriers. The American Medical Association recommends that patient education materials not exceed a sixth grade reading level,<sup>34</sup> which could be generalized to visitor-directed signs.

### Future Directions

The sign design recommendations outlined in **Table 7** were adapted from other disciplines and future research should focus on optimization to address visitor behavior in a healthcare setting. For example, future studies should include a component analysis of design characteristics to identify features that have the greatest impact on visitor behavior. Additionally, future studies of visitor-related intervention should consider factors that may influence visitor decision-making and likelihood of engaging in desired behavior, such as effort required to follow instructions,<sup>41</sup> perceived risk of harm,<sup>41</sup> and familiarity<sup>26</sup> with a patient's care.

The potential safety strategies consisting of a policy of locking infusion pumps when staff are not in the room and use of infusion pumps with an auto-locking feature should be tested to measure feasibility (e.g., time to implement and maintain, cost of purchasing new or upgraded equipment), unintended consequences, and the extent to which they may influence behavior. The proposed change to the design of bed or chair alarms requires extensive and rigorous testing to ensure the benefits outweigh any potential risks.



### Limitations

This study covered only a six-month period and our findings may not be representative of other times of the year. Also, we chose a time frame that was prior to the COVID-19 pandemic, so our findings likely do not represent current challenges with visitors and patient care. The exclusion of pediatric patients and other care areas (e.g., emergency department, labor and delivery) limits the generalizability of our findings due to potential differences in visitor involvement and interaction with patients. The number of events that involved visitors who decreased the risk of patient harm may be underrepresented due to the visitor behavior preventing an event from occurring. Also, it is likely that the number of reported events that actually involved visitors are underrepresented due to staff being unaware of, or failing to note, visitor involvement in the event.

### Conclusion

Results from this study revealed that visitors can contribute to an increased or decreased risk of patient harm through multiple behaviors and across multiple event types. This study also identified visitor behaviors and event types that should be prioritized when designing more rigorous interventions to influence visitor behavior. For example, visitors communicating with staff was overwhelmingly associated with a decreased risk of patient harm and impacted all seven event types, suggesting that interventions that encourage this behavior could have a positive impact on patient safety. Visitor behaviors that were most frequently associated with an increased risk of patient harm were moving

**Table 5.** Summary of Visitor Behaviors That Could Influence the Risk of Patient Harm

Visitor Behavior Category	Visitor Behaviors to Encourage	Visitor Behaviors to Discourage
Communication with staff	Alert staff to: <ul style="list-style-type: none"> <li>• New or worsening symptoms</li> <li>• Falls</li> <li>• Medication discrepancies</li> </ul>	Interrupting staff for nonurgent communication or questions while they are carrying out care tasks.
Involvement in moving patient or patient's physical stability	In the event of a fall, lower patient to the floor or to another horizontal surface. Ask staff for assistance if a patient wishes to exit the bed or ambulate.	Helping a patient ambulate, unless approved by staff. Transporting a patient from one unit to another without staff assistance.
Providing or removing items	Remove potentially harmful items from patients, such as known allergens.	Providing potentially harmful items to patients, such as home medications.
Manipulating equipment or devices	Before leaving, ensure the call bell is within reach of the patient. Inform staff of equipment or device issues (e.g., inactive alarms, disconnected tubing, dislodged breathing or feeding apparatuses).	Moving or disconnecting lines or tubing. Deactivating alarms set by staff. Unplugging or pressing buttons on equipment or devices.

**Table 6.** Potential Safety Strategies Targeting Visitor Behaviors and Associated Event Types

	Potential Safety Strategy	Visitor Behavior(s)	Event Type(s)	Considerations
<p style="text-align: center;">Least</p> <p style="text-align: center;">↑</p> <p style="text-align: center;">Time and effort required to develop, implement, and maintain intervention</p> <p style="text-align: center;">↓</p> <p style="text-align: center;">Greatest</p>	Display warning and instructional signage. <sup>20</sup>	<ul style="list-style-type: none"> <li>• Communicating with staff</li> <li>• Moving or physically stabilizing patient</li> <li>• Providing or removing items</li> <li>• Manipulating equipment or a device</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Falls</li> <li>• Medication-related</li> <li>• Integrity of care</li> <li>• Change in condition</li> <li>• Skin-related</li> <li>• Dietary/nutrition</li> <li>• Other</li> </ul>	Designing effective signs can be difficult; therefore, we provide guidance for effective sign design in <b>Table 7</b> and the corresponding section.
	Implement a policy that infusion pumps must be locked when appropriate, <sup>24</sup> which could prevent visitors from manipulating the device.	Manipulating equipment or a device	Medication-related	<ul style="list-style-type: none"> <li>• Requires staff vigilance; therefore, integrity likely will be less than optimal.</li> <li>• Perceptive visitors may circumvent this by watching staff enter the code.<sup>25</sup></li> </ul>
	Use infusion pumps with auto-locking keypads, when appropriate, which could prevent visitors from manipulating the device.	Manipulating equipment or a device	Medication-related	<ul style="list-style-type: none"> <li>• Older infusion pumps may not have this feature, requiring facilities to purchase new pumps.</li> <li>• Auto-locking keypads could carry a risk of unintended consequences, so decisions for their use must be weighed carefully.</li> </ul>
	Develop and implement educational programs for visitors. <sup>15</sup>	<ul style="list-style-type: none"> <li>• Communicating with staff</li> <li>• Moving or physically stabilizing patient</li> <li>• Providing or removing items</li> <li>• Manipulating equipment or a device</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Falls</li> <li>• Medication-related</li> <li>• Integrity of care</li> <li>• Change in condition</li> <li>• Skin-related</li> <li>• Dietary/Nutrition</li> <li>• Other</li> </ul>	<ul style="list-style-type: none"> <li>• Will likely need to design multiple educational programs, each targeting one or two visitor behaviors.</li> <li>• Requires staff vigilance; therefore, integrity likely will be less than optimal.</li> </ul>
	Bed or chair alarm manufacturers should consider designing and incorporating a feature that locks the alarm setting, which could prevent visitors from manipulating the device.	<ul style="list-style-type: none"> <li>• Manipulating equipment or a device</li> <li>• Moving or physically stabilizing patient</li> </ul>	Falls	<ul style="list-style-type: none"> <li>• The proposed design would need to be rigorously tested with users to assess for unintended consequences.</li> <li>• Requires staff vigilance; therefore, integrity likely will be less than optimal.</li> <li>• Perceptive visitors may circumvent this by watching staff enter the code.<sup>25</sup></li> </ul>

**Note:** These strategies are based on existing literature, current practices, and creative thinking, and may help to advance patient safety. Readers should critically review the proposed strategies and consider the risk of unintended consequences prior to implementation. Inclusion of these strategies does not constitute an endorsement or formal recommendation by the authors or the Patient Safety Authority.



**Table 7.** Design Recommendations for Effective Signage

Design Factor	Recommendations
Color	<ul style="list-style-type: none"><li>• Red, orange, and yellow tend to convey the greatest levels of hazard compared to other colors.<sup>26</sup></li><li>• Blue and green tend to convey general information.<sup>28</sup></li></ul>
Font	<ul style="list-style-type: none"><li>• Text should be easy to read from a distance.</li><li>• Bold type can be used to emphasize hazard level.<sup>26</sup></li></ul>
Format and Sequence	<ul style="list-style-type: none"><li>• Lists are more likely to be read than long sentences and paragraphs.<sup>26</sup></li><li>• Instructions should match the sequence of tasks.<sup>35</sup></li></ul> <p><i>For example, if visitors should call for help after a change in patient condition, signs should read “if you see these symptoms, call for help” as opposed to “call for help if you see these symptoms.”</i></p>
Language and Terminology	<ul style="list-style-type: none"><li>• Signs should present information in multiple languages, depending on the patient population.</li><li>• Avoid the use of acronyms and medical terminology; use lay language.<sup>36</sup></li><li>• Language used should not exceed a sixth grade reading level.<sup>34</sup></li></ul>
Location	Signs should be posted closest to the point of the desired behavior. <sup>38-39</sup>
Size	Bigger is better. <sup>26</sup>
Specificity	Specific warnings and instructions are more effective than general warnings and instructions. <sup>26</sup> <i>For example, a previous study replaced the phrase “call staff” with “press the red button” to encourage communication with staff.<sup>15</sup></i>
Symbols or Pictorials	Graphics are helpful for individuals with low literacy or a language barrier and can increase efficiency of interpretation. <sup>26,40</sup>

a patient, providing items to a patient, and manipulating equipment or a device.

Overall, this study has revealed that many visitors to hospitals require guidance about which behaviors can be helpful and which can be harmful. The use of warning and instructional signage can be a first-choice strategy to guide visitor behavior because it requires relatively minimal time and effort to implement. We hope that the results from this study, combined with the information provided in **Table 5**, **Table 6**, and **Table 7**, will assist staff and facilities in leveraging visitor presence to increase patient safety.

## Notes

This analysis was exempted from review by the Advarra Institutional Review Board.

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