FINDINGS

FALLS:
Mitigating Risk in Healthcare Facility Design
A Module on a Safety Risk Assessment Component

THIS SAFETY MODULE INCLUDES:

Backgrounder
Design Strategies
Issue Brief

This module was created as a supplement to the Safety Risk Assessment (SRA) toolkit and other SRA-related Issue Briefs, Backgrounders, and Top Design Strategies. This toolkit is not intended to be a guarantee of a safe environment; the environment is one part of a safety solution that includes operational policies, procedures and behavior of people. It is intended for use with collaborative input of project- and facility-based expertise.

The Safety toolbox is made available through a partnership with

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This document will be updated in 2018 to be a stand-alone reference under the Grainger sponsorship.
One of the first papers analyzing hospital falls was published in the late 1950s (Fine, 1959). Since that time, numerous studies have identified risk factors and potential interventions for hospital falls. Many studies cite that certain patient groups might be more “at risk” for falls. For example, one study found that most falls occurred in geriatric wards (Schwendimann, 1998), while others have documented high rates of falls and falls with injury in medicine, neurology, and oncology (Hitcho et al., 2004). Factors correlated with risk for falls include age, mental status, illness severity, a prior fall, and the use of certain medications (Chelly et al., 2008; Hitcho et al., 2004; Oliver, Daly, Martin, & McMurdo, 2004). While age is a factor, it should be noted that falls can occur at any age, including pediatric populations.

Studies also show a range of fall locations in patient units ranging from 52–85% in the patient room (37–50% getting to the toilet) or the patient bathroom (8–29%). Others occur in corridors (6–7.4%) or stairs, as well as from chairs (8–16%) (Ash, MacLeod, & Clark, 1998; Brandis, 1999; Hathaway, Walsh, Lacey, & Saenger, 2001; Morgan, Mathison, Rice, & Clemmer, 1985). Non-patient care areas correlated with a higher risk of falls for all occupants (e.g., staff, visitors) include food service areas; areas surrounding drinking fountains and soap dispensers; and building entrances (Bell, Collins, Dalsey, & Sublet, 2010). Waiting areas, dressing rooms, and procedure tables have also been identified as fall locations in diagnostic and treatment areas (Anonymous, 2011).

Injury levels (see the sidebar) are often assessed as part of risk, and the degree of potential harm may vary across at-risk populations. Studies often include multifactorial solutions suggesting an increasing number of interventions depending upon whether the risk is low, medium, or high. The National Quality Forum (NQF) named falls and trauma as a “never event.” When never events were originally defined, they included 28 medical errors that were considered unambiguous, serious, and usually preventable. (Never events are now often called “serious reportable events,” or SREs.) In 2008, the U.S. Centers for Medicare and Medicaid ceased reimbursement for certain never events, including inpatient hospital falls. Falls are now included as part of a patient safety indicator (PSI) measure.
References


Safety Risk Assessment: Falls

Design Strategies

The following design solutions are a brief summary of the content found in the SRA Issue Brief "Falls: Mitigating Risk in Healthcare Facility Design." They are organized by building design category.

Building Envelope

- Falls can be caused by environmental hazards, such as slippery floors. Entrances into the building, for both staff and patients, should be protected from the weather.

Unit Layout

- Conditions associated with unit layout include:
  - Patient visibility and accessibility by staff;
  - Easy access to the patient by family members or sitters who may be observing when patients need to get in and out of bed; and
  - Environmental hazards of obstacles or clutter, such as equipment that may no longer be in use but does not have a convenient storage location out of the path of travel.

Room Layout

- Considerations should include the placement of the bathroom, balancing distance to the bathroom for patients who may be weak with visibility to the bathroom for patients who may be confused.
- Additional considerations should take into account reach and strength as they relate to the ability to open doors into the bathroom while manipulating a walker or IV pole, as well as the accessibility of nurse call devices.

Flooring

- Flooring is a complex design issue that includes the floor finish and the subfloor, which act together as a system. Flooring considerations include:
  - Smooth transitions (e.g., level or material changes);
o Surface characteristics that affect balance and gait (e.g., slip resistance);

o Perceptual hazards (e.g., contrast, glare, color, and patterns); and

o Biomechanical forces of a fall that contribute to injury as a result of the overall floor system (e.g., combined subfloor/floor characteristics for impact resistance).

**Lighting**

- Solutions should take into account visual acuity by eliminating extremes in contrast due to natural or artificial light and low-level nighttime lighting that does not disrupt sleep.

**Assistive Devices**

- A consideration rising out of human biomechanics and anthropometrics is the use of grab bars, especially for the elderly who often have weakened lower body strength and poor balance.

- In bathrooms, considerations include the use, positioning, and orientation of assistive devices such as grab bars for both ambulating (sit-to-stand use) and non-ambulating (transfer use) patients.

**Furniture**

- Conditions related to furniture include selection and specification (versus the design of a building or unit)—important decisions that are often lost in a silo of the larger design project. Latent conditions for patient furniture can include:
  
  o The inability to transfer out of bed due to height or side rails;

  o A lack of familiarity with the environment, including bed (and toilet) height, compared with furniture found at home; and

  o Environmental hazards of instability and/or restraint.

- Staff falls can also be influenced by unstable furniture. Some suggest adjustable furniture may lead to reduced staff fatigue, a contributing risk for falls.

**Technology and Materials to Reduce Noise**

- A less researched area is the contribution of noise to the risk of falls. Several studies reference the contribution of noise to confusion, restlessness, and sleep disturbances, all of which may contribute to the risk of falls. The selection of technologies and materials to reduce disruptive noises is one part of a strategy to improve both sleep and healing.
• Signage: Visual cues, such as signage, can alert staff, visitors, and family members to a patient’s risk for a fall.

Additional Resources


Additional resources not focused on design:

Joint Commission (http://www.jointcommission.org/assets/1/6/2015_NPSG_NCC.pdf)

CMS: Falls as HAC National Guideline Clearinghouse (http://www.guideline.gov/resources/hospital-acquired-conditions.aspx)

Pennsylvania Patient Safety Authority (http://patientsafetyauthority.org/ADVISORIES/AdvisoryLibrary/2012/Jun;9%282%29/Pages/47.aspx)

University of Texas Health Science Center (http://uthscca.edu/cphp/CSEProject/Falls%20Reduction%20in%20the%20Christus%20Santa%20Rosa%20ACE%20unit.pdf)

Department of Veterans Affairs National Center for Patient Safety (VA NCPS) (http://www.patientsafety.va.gov/professionals/onthejob/falls.asp)

CDC’s National Institute for Occupational Safety and Health (NIOSH) (http://www.cdc.gov/niosh/docs/2011-123/)

AHRQ (http://www.ahrq.gov/professionals/systems/hospital/fallpxtoolkit/index.html)

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FINDINGS

FALLS:
Mitigating Risk in Healthcare Facility Design

An Issue Brief on a Safety Risk Assessment Component

INSIDE YOU WILL LEARN ABOUT:

Conditions that contribute to the risk of falls in healthcare settings.

Human limitations that should be considered when mitigating the risk of falls through design.

Design strategies that should be considered as part of a multifactorial solution for falls prevention.

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Safety Risk Assessment for Healthcare Facility Design: Mitigating Risk of Falls

January 2017

Executive Summary

Falls were one of 28 medical errors identified by the National Quality Forum (NQF) as a “never event”: unambiguous, serious, and usually preventable. In 2008, the U.S. Centers for Medicare and Medicaid ceased reimbursement for certain injuries associated with hospital falls. Risk factors for falls include intrinsic and extrinsic conditions—those related to the individual, and those outside of the individual, including the environment. Latent (underlying) conditions that contribute to the risk of falls include:

- Visibility of and accessibility to patients, from both a staff and family perspective;
- Distance to the bathroom (related to frailty);
- Bathroom identification due to cognitive limitations (related to confusion);
- The accessibility of personal items, nurse call technology, and assistive devices such as grab bars, due to physical limitations (i.e., anthropometrics, strength);
- Glare, improper lighting, or inadequate contrast aggravated by perceptual limitations, including visual acuity;
- Specific environmental hazards that contribute to slips, trips, and falls, such as slippery floors due to weather (e.g., ice, snow, rain) or other contamination (e.g., spills, urine); the presence of obstacles in the path of travel, such as equipment, cords, tubing, or clutter; flooring characteristics and design conditions; and furniture that inhibits mobility;
- Noise, leading to sleep disturbances that may increase fatigue and risk of falls; and
- A lack of awareness of fall risk due to inadequate visual cues such as signage.

This brief is a summary of information gathered during the development of The Center for Health Design Safety Risk Assessment (SRA) toolkit as it pertains to the topic of falls in healthcare settings. See the associated Backgrounder for additional context.
These latent conditions can, in part, be mitigated by facility design that addresses the building envelope, unit layout, room layout, material selection, lighting, assistive devices (i.e., grab bars), furniture selection, technology, and signage. Solutions should also take into account the organizational and clinical policies and procedures, as well as the workflow, behavior, and limitations of caregivers, staff, and patients who use the facility.

Mitigating the Risk of Falls With Environmental Design

Exterior and Building Envelope

Slips, trips, and falls can be caused by wet or slippery floors resulting from contamination from weather (e.g., rain, ice, snow). Canopies can protect entrances from inclement weather, while walk-off mats wide enough to cover the door width and long enough to capture several steps can reduce the tracking of contamination into the building (The Joint Commission, 2012). Umbrella bags can provide temporary measures (The Joint Commission, 2012) but should not become obstructions in the path of travel.

Unit Layout

Many studies suggest locating higher-risk patients closest to the nurse/team station (Galbraith, Butler, Memon, Dolan, & Harty, 2011; Gutierrez & Smith, 2008; Hathaway, Walsh, Lacey, & Saenger, 2001; Hitchco et al., 2004; Kilpack, Boehm, Smith, & Mudge, 1991; Krauss et al., 2008) or monitoring patient activity using bed alarms (Barker, Kamar, Morton, & Berlowitz, 2009; Carroll, Pappola, & McNicoll, 2009; Gurascio-Howard & Malloch, 2007; Kolin, Minnier, Hale, Martin, & Thompson, 2010; Krauss et al., 2008; McKinley et al., 2007; Morton, 1989; Spetz, Jacobs, & Hatler, 2007). While this may be seen as operational, unit layout can support improved visibility and proximity through:

- The unit shape, to provide better sight lines (Amato, Salter, & Mion, 2006; Choi, Noblis, & Georgia Tech, 2011; Vassallo, Azeem, Pirwani, Sharma, & Allen, 2000);
- The location of common tasks, to be near the patient (e.g., charting) (Choi et al., 2011; Gutierrez & Smith, 2008);
- Visibility of the patient’s head, including from the corridors with a normal walking pattern (Choi et al., 2011).
While layouts should be designed to afford visibility, some study interventions included assignments to specially equipped rooms (i.e., video surveillance) (Hardin, Dienemann, Rudisill, & Mills, 2013; Hitcho et al., 2004).

**Room and Unit Layout**

While there is no empirical research linking reduced falls to family zones in patient rooms, providing a family-friendly environment may mitigate the risk of falls. Many organizations encourage the use of families or sitters to stay with high-risk or confused patients to increase surveillance (Fonda, Cook, Sandler, & Bailey, 2006; Kilpack et al., 1991; Krauss et al., 2008; McCarter-Bayer, Bayer, & Hall, 2005). Families sometimes assist patients with ambulation (Tzeng & Yin, 2008b). In one study, falls were reduced by nearly half in patient rooms that had designated family space, as compared to those without (Calkins, Biddle, & Biesan, 2012).

While weather-related contamination is one type of environmental hazard that contributes to slips, trips, and falls, additional hazards include obstacles of equipment, cords, or general clutter. This also may appear to be an operational issue, but it is influenced by the room and unit layout. A layout designed without sufficient space for furniture, equipment, and cords may inherently create obstacles for staff and patients; many studies cite clutter as a condition of falls, or removal of clutter as an intervention to reduce fall risk (Anonymous, 2011; Bell, Collins, Dalsey, & Sublet, 2010; Carroll et al., 2009; Gutierrez & Smith, 2008; Hitcho et al., 2004; Kilpack et al., 1991; Kolin et al., 2010; McKinley et al., 2007; Neiman, Rannie, Thrasher, Terry, & Kahn, 2011; Ruckstuhl, Marchionda, Salmons, & Larrabee, 1991; Szumlas, Groszek, Kitt, Payson, & Stack, 2004; Tzeng & Yin, 2008b). Inadequate storage facilities within the room or unit can lead to unused equipment being left out, potentially in the path of travel.

**Room Layout**

Research concerning the location of the bathroom on the headwall versus the footwall is limited and inconclusive, although a recent study found lower fall rates when the bathroom was on the footwall (Calkins et al., 2012). Needs should be considered based on patient frailty and confusion (Hignett, Sands, & Griffiths, 2011, 2013), including the patient path to the bathroom (distance considerations associated with frailty), bathroom visibility for the patient
One study found that bathroom locations visible from the bed, with the door open and out of the way, resulted in fewer falls (Calkins et al., 2012). It is possible that confused patients were better able to find and navigate to the bathroom when they did not have to manage opening a door. One review referenced angled door and room layouts to provide better sight lines (Gulwadi & Calkins, 2008). A recent study also found that rooms with 18 inches of space on the opening side of the door had a lower rate of falls (Calkins et al., 2012). It may be that this made it possible to open the door without stepping backward, more effectively allowing patients to maneuver IV poles, walkers, and other assistive devices.

Although specific locations of call devices are not referenced (e.g., bed, chair, toilet room), research papers often cite placing the call button within reach of the patient as an intervention to reduce falls (Hunderfund, Sweeney, Mandrekar, Johnson, & Britton, 2011; Kilpack et al., 1991; Lockwood & Anderson, 2013; Ruckstuhl et al., 1991; Schwendimann, 1998; Szumlas et al., 2004). Anthropometric consideration should be made for how the patient might reach the call device; a device located on the wall behind the toilet will be out of reach of many patients/residents. Patients may fall while trying to reach an inaccessible device.

Flooring

Changes in floor surfaces can contribute to falls (Anonymous, 2011; Yang & Hu, 2009). This includes conditions such as transitioning from a soft surface to a hard surface and/or moving from a slip-resistant surface to a non-slip-resistant surface. Additionally, unevenness, such as minor changes in height between flooring materials requiring transition strips, as well as holes and cracks needing repair, can create tripping conditions that contribute to falls (Anonymous, 2011; Bell et al., 2010). Floor coverings that can roll up, buckle, or create a trip hazard due to thickness have been indicated as a contributor to employee, visitor, and patient falls. This includes loose or frayed carpets and/or rugs, as well as mats or runners laid out temporarily during inclement weather or in service areas (e.g., cafeteria kitchens) (Bell et al., 2010). Permanently affixed methods, recessed
into the floor, may offer more control of surface irregularities, although material transition is still a consideration.

Shiny floors may contribute to falls by creating confusion about whether the floor is slippery (Joh, Adolph, Campbell, & Eppler, 2006). One study found that a shiny floor was always perceived as unsafe (Zamora, Alcantara, Artacho, & Cloquell, 2008), and another suggests cleaning practices that reduce high-shine finishes, such as wax (Fonda et al., 2006). When a surface is perceived as slippery, patients may change their step length, walking speed, or the surface contact (Llewellyn & Nevola, 1992). The elderly have a lower ability to adapt, and this may contribute to decreased mobility (due to fear of falling); this, in turn, can result in decreased leg strength, further contributing to fall risk.

The elderly are more reliant on vision for stabilization, and poor visual acuity can double the risk of falls, with contrast sensitivity playing a role (Harwood & Ebrahim, 1992). One suggested intervention includes contrast between floors and walls to better define the walking surface (including between the toilet and the surrounding floor and wall area) (Gulwadi & Calkins, 2008). A study related to carpet patterns and the elderly found that patterns featuring large areas of dark value next to areas of light value might be misinterpreted as shadows, changes in height, or objects on the floor (Perritt, McCune, & McCune, 2005). Additionally, light can create shadows that may be incorrectly perceived as a level change (Gulwadi & Calkins, 2008).

With respect to slip resistance, flooring selection should consider more than the coefficient of friction (CoF), recognizing that multiple factors contribute to the slip resistance of a floor. Previously accepted ASTM testing methods (ASTM C1028-07e1) to determine the static CoF of ceramic tile and other like surfaces have been withdrawn (http://www.astm.org/Standards/C1028.htm), and it is important to understand the testing method used to determine slip resistance. In addition to CoF, factors influencing slip resistance include wet versus dry
conditions; wear and maintenance; and interactions with footwear, such as treads or heel height.

Certain materials may contribute more or less to the risk of falls, as well. In one study, linoleum flooring in both bedrooms and bathrooms was associated with more falls than either vinyl composition tile (VCT) or vinyl (Calkins et al., 2012). Research also shows that softer underlays (e.g., wood versus concrete) may contribute to a reduction in injuries associated with patient falls through energy absorption. It is important to consider the balance between the “softness” of impact resistance and its effect on both walking gait and balance (as well as rollability from a staff perspective), as there is some evidence of reductions in injurious falls that are accompanied by an overall increase in fall rates (Drahota et al., 2013). The complexities of these many considerations are discussed more fully in The Center for Health Design report Achieving EBD Goals Through Flooring Selection & Design (Nanda, Malone, & Joseph, 2012).

**Lighting**

Perception and visual acuity are affected by both illumination levels and the quality or evenness of light. Improper lighting can be a hazard for both staff and patients when it hides obstructions or does not allow visualization of the floor and equipment (Anonymous, 2003). This condition can exist in many locations, such as surgical suites, diagnostic and treatment areas, and patient rooms. Poor lighting can also lead to confusion in some patients, leading to risk of falls (Oliver, 2007). In areas where monitors are used (e.g., procedure rooms, ORs), the contrast between the dimmed area for the monitor and surrounding bright areas may make it difficult to adapt vision (Anonymous, 2011; Brogmus, Leone, Butler, & Hernandez, 2007). This may also be true between patient rooms and hallways at night, or where procedures are brought to the bedside and the surrounding space is dimmed.

Given the prevalence of nighttime falls and falls en route to toileting, most implemented strategies suggest some form of low-level night lighting to help the patient navigate to the bathroom (Chen, Chen, & Su, 2010; Healey, 1994; Kilpack et al., 1991; Morse, 1998; Morton, 1989; Tzeng & Yin, 2008b). Nighttime lighting is intended to illuminate the path between the room entry/bed and the bed/toilet, but should not be so bright as to disrupt sleep.
GRAB BARS

Another consideration arising out of human biomechanics and anthropometrics is the use of grab bars, especially for the elderly, who often have weakened lower body strength and poor balance.

In bathrooms, considerations include the use, position, and orientation of assistive devices such as grab bars for both ambulating (sit-to-stand use) and non-ambulating (transfer use) patients.

Permanent Assistive Devices (Grab Bars)

While research has not confirmed the benefit of handrails from the patient bed to bathroom, expert opinions support their use (Kolin et al., 2010; Lowery, Buri, & Ballard, 2000; Tzeng & Yin, 2010). They should support patient weight while ambulating, and some suggest prompting visibility at night through the use of sensors and low-level lighting (Kolin et al., 2010).

As weakened lower body strength is often a condition of older patients, research indicates that grab bars on both sides of the toilet help the patient with the required upward force, as compared with the sink (Fink, Pak, & Battisto, 2010). One study found that there were almost four times more falls with wall-mounted grab bars as with grab bars on both sides of the toilet (Calkins et al., 2012). Folding grab bars can be considered adjacent to the toilet. Additionally, handrails and grab bars in the bathroom and shower are often at awkward heights that require excessive bending and/or reaching. Some experts propose that the addition of grab bars at a secondary height is useful to address a varied population (Tzeng & Yin, 2010). It should be noted that optimal configuration of grab bars likely exceeds the regulatory requirements found in the U.S. 2010 ADA Standards for Accessible Design.

Plumbing Fixtures

Another factor associated with weakened lower body strength is the height of the toilet, which may be different than what is used at home (and further contribute to a lack of familiarity with the environment). As some studies reference low toilet height as a risk for falls (Fink et al., 2010; Lowery et al., 2000), temporary solutions may include raised toilet seats or bedside commodes with locking wheels (Kilpack et al., 1991; Krauss et al., 2008; Morton, 1989; Schwendimann, 1998; Tzeng, 2011).

Furniture

Numerous studies indicate that adjustable-height beds used in a low or low-low position (i.e., lowered to the floor) can reduce fall rates (Barker et al., 2009; Fonda et al., 2006; Hunderfund et al., 2011; Kolin et al., 2010; Krauss et al., 2008; McKinley et al., 2007; Morton, 1989; Neiman et al., 2011; Quigley et al., 2009; Ruckstuhl et al., 1991; Schwendimann, 1998; Szumlas et al., 2004; Tzeng & Yin, 2008b). However, even in a low position, hospital bedframes are often 8
to 12 feet higher than a home bed (Tzeng & Yin, 2008a), and this contributes to the lack of familiarity with the environment. A higher bed height also contributes to a greater risk of injury due to the increased gravitational potential energy (i.e., downward pull). Research indicates that the height of the bed from the floor to the top of the bed should be adjustable to the patient knee height (Tzeng & Yin, 2008a).

Another design feature associated with beds is the configuration of bedrails. Studies find the use of bedrails and restraints do not contribute to a reduced rate of falls (Capezuti, 2004) and may contribute to an increased risk of falls (Ash, MacLeod, & Clark, 1998; Capezuti, Strumpf, Evans, Grisso, & Maislin, 1998; Hanger, Ball, & Wood, 1999; van Leeuwen, Bennett, West, Wiles, & Grasso, 2001), as well as serious injury or death by entrapment (Healey, Oliver, Milne, & Connelly, 2008). However, some recent studies indicate this intervention is in place as a reminder to call for assistance (Lockwood & Anderson, 2013; Neiman et al., 2011). Other studies suggest split side rails that can provide some support for lying/sitting/standing while transferring in and out of bed with the bottom part down on the exit side. This offers some support but allows egress (Gutierrez & Smith, 2008; Healey et al., 2008). This is not to say that rails should not be used during transport or considered during procedures. One study found that the use of portable padded side rails during pediatric surgery reduced the risk of patient falls from the table during surgery (Redman & Mcnatt, 2000).

There are certain features of furniture that contribute to the risk of falls and do not support independent mobility. For example, chair lap trays have been cited as a risk factor for entrapment and can be defined as restraints, despite their intended purpose. In some cases, lap trays may be attached to chairs to prevent people from getting up without assistance (Tan et al., 2005). Unstable furniture has also been cited as a risk factor for falls (Gulwadi & Calkins, 2008). This is
problematic for both general sit-to-stand use cases, as well as when the
furniture is used to support ambulation (furniture walking). This is also a
consideration for procedure and treatment spaces. A report on the risk of falls
in radiology areas found that falls were associated with the instability of
procedure tables when patients were entering or exiting (Anonymous, 2011).

Staff slips, trips, and falls can be exacerbated by fatigue. A best practice paper
on operating room design suggests ergonomically adjustable furniture and
equipment, as well as standing workstations with padded leaning rests
(Brogmus et al., 2007). This may apply to other staff work areas as well.

Technology
Noisy environments can result in confusion in older hospitalized patients,
sometimes leading to restlessness and the risk of falls (Oliver, 2007). One study
found that when both overhead paging and alarms were rated as occurring
“frequently,” falls were statistically higher (Calkins et al., 2012). This may be, in
part, due to fatigue associated with a diminished quality of sleep.

Other Material Selections
Sleep disturbances (e.g., noise, anxiety, pain, the need to urinate) are common in
older people and are associated with their risk of falling (Hill, Cumming, Lewis,
Carrington, & le Couteur, 2007). Noise reduction can improve sleep. Noise is
often generated by conversations, foot traffic, and movement of carts and
equipment, and can be mitigated with material selection. High performance
ceiling tile, flooring, and acoustical wall coverings can aid in reducing both sound
levels and reverberation.

Signage and Visual Cues
Awareness is another underlying condition of falls. Numerous studies reference
visual cues so that staff and visitors are alerted to a fall risk condition.
This includes a combination of signage, colored wrist bands,
footwear, and even blanket color. Visible signage at the door and,
sometimes, at the patient headwall is

TECHNOLOGY AND
MATERIALS TO REDUCE
NOISE

A less researched area is the
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Visual cues, such as
signage, can alert
staff, visitors, and
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patient’s risk for a fall.
part of a visual intervention cited in multiple studies (Ang, Mordiffi, & Wong, 2011; Barker et al., 2009; Carroll et al., 2009; Dykes & Carroll, 2010; Hunderfund et al., 2011; Kilpack et al., 1991; Krauss et al., 2008; Morton, 1989; Neiman et al., 2011; Schwendimann, 1998). However, because signage is most often considered later in the design process, suitable wall space at the room entry is often lacking.

**Conclusion**

Falls are complex and cannot be solved with any single intervention. The built environment alone is not a cure, but creating an optimal environment can mitigate the risk of falls. As such, the multifactorial approach needs to consider the interactions of the built environment, the limitations of the people in the system (both patients and staff), and organizational and operational policies and procedures.

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**References**


