SUPPLEMENT | Annals of Internal Medicine

Inpatient Fall Prevention Programs as a Patient Safety Strategy

A Systematic Review

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Falls are common among inpatients. Several reviews, including 4 meta-analyses involving 19 studies, show that multicomponent programs to prevent falls among inpatients reduce relative risk for falls by as much as 30%. The purpose of this updated review is to reassess the benefits and harms of fall prevention programs in acute care settings and to identify factors associated with successful implementation of these programs. We searched for new evidence using PubMed from 2005 to September 2012. Two new, large, randomized, controlled trials supported the conclusions of the existing meta-analyses. An optimal bundle of components was not identified. Harms were not systematically examined, but potential harms included increased use of restraints and sedating drugs and decreased efforts to mobilize patients. Eleven studies showed that the following themes were associated with successful implementation: leadership support, engagement of front-line staff in program design, guidance of the prevention program by a multidisciplinary committee, pilot-testing interventions, use of information technology systems to provide data about falls, staff education and training, and changes in nihilistic attitudes about fall prevention. Future research would advance knowledge by identifying optimal bundles of component interventions for particular patients and by determining whether effectiveness relies more on the mix of the components or use of certain implementation strategies.

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The Problem

The reported rate of falls in acute care hospitals ranges from 1.3 to 8.9 per 1000 bed-days (1). Higher rates are reported in neurology, geriatrics, and rehabilitation wards. Because falls are probably underreported, most estimates may be overly conservative (1). Defining a "fall" is a challenge in itself (2, 3). For example, the National Database of Nursing Quality Indicators defines a fall as "an unplanned descent to the floor with or without injury" (4), whereas the World Health Organization defines a fall as "an event which results in a person coming to rest inadvertently on the ground or floor or some lower level" (5).

Regardless of the definition, falls occur frequently and can have serious physical and psychological consequences. Between 30% and 50% of in-facility falls result in injuries (6, 7). Falls are associated with increased health care use, including increased length of stay and higher rates of discharge from hospitals into long-term care facilities. Even a fall that does not cause an injuty can trigger a fear of falling, anxiety, distress, depression, and reduced physical activity. Family members, caregivers, and health care professionals are susceptible to overly protective or emotional reactions to falls, which can affect the patient's independence and rehabilitation.

A fall is often the result of interactions between patient-specific risk factors and the physical environment. The former risk factors include patient age (particularly older than 85 years), history of a recent fall, mobility impairment, urinary incontinence or frequency, certain medications, and postural hypotension. The latter include poor lighting; "trip" hazards, such as uneven flooring or small objects on the floor; suboptimal chair heights; and limited staff availability or skills. Because in-facility falls can be precipitated by many factors and patients who fall often have several risk factors, multicomponent interventions are believed to be necessary for prevention. The purpose of this updated review is to reassess the benefits and harms of multicomponent inpatient programs for fall prevention and to assess the factors associated with successful implementation of such programs.

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Patient Safety Strategies

All of the multicomponent fall prevention strategies in recent meta-analyses included an assessment of fall risk (often the Morse Fall Scale [8] or St. Thomas's Risk Assessment Tool in Falling Elderly Inpatients [9] is used). **Table 1** lists additional components commonly included in multicomponent interventions. These typically include staff and patient education, a bedside risk sign or an alert wristband, attention to footwear, a toileting schedule, medication review, and a review after the fall to identify causes. Although most in-facility fall prevention programs are multicomponent interventions, none of the controlled trials explicitly articulated a conceptual framework underpinning its intervention. Individual components of published strategies varied in type, intensity, duration, and targeting, and none of the trials that evaluated multicomponent interventions used the same combination of components. **Table 1** of the **Supplement** (available at www.annals.org) shows data about components of fall prevention strategies from studies addressed in this review.

Review Processes

We identified 4 recent existing reviews that were relevant to the topic of inpatient fall prevention. Reviews of

Table 1. **Intervention Components in Studies of Inpatient Falls Prevention Programs**

Component	Studies Including This Component, *n*
Patient education	11
Bedside risk sign	10
Staff education	9
Alert wristband	7
Footwear	7
Review after fall	7
Toileting schedules	7
Medication review	6
Environment modification	5
Movement alarms	5
Bedrail review	4
Exercise	4
Hip protectors	3
Urine screening	2
Vest, belt, or cuff restraint	1

The 4 reviews we identified reached similar conclusions. The reviews by Cameron and colleagues (12) and Oliver and coworkers (14) found that multicomponent in-facility prevention programs result in statistically and clinically significant reductions in rates of falls. Cameron and colleagues included 6478 older adults from 4 randomized trials in a pooled analysis that found a 31% decrease in the rate of falling (pooled rate ratio [RR], 0.69 [95% CI, 0.49 to 0.96] and a 27% decrease in the incidence of falls when compared with usual care among 3 trials involving 4824 participants (RR, 0.73 [CI, 0.56 to 0.96]) (12). Oliver and coworkers (14) included 5 randomized trials and 8 before-and-after studies in a pooled analysis that found an 18% decrease in the rate of falling (RR, 0.82 [CI, 0.68 to 1.00]). Coussement and colleagues (13) included 2 randomized trials, 1 before-and-after study, and 1 cohort study and found a pooled RR similar to that of Oliver and coworkers; however, this effect was not quite statistically significant (RR, 0.82 [CI, 0.65 to 1.03]). DiBardino and colleagues' review (15) pooled data from 6 studies (including 1 randomized trial, 1 quasi-experimental study, and 4 before-and-after studies) and found a pooled odds ratio of 0.90 (CI, 0.83 to 0.99). The studies included in these reviews used interventions with 3 to 7 components and compared them with control participants who received usual care (for example, "control ward had no trial intervention" [23] and control participants who "followed conventional routines" [33]).

We rated the first trial identified in our update search as having a low risk of bias. In this cluster randomized trial, Dykes and coworkers (24) compared the fall rates in 8 units at 4 urban U.S. hospitals over a 6-month period. Control units in each hospital received usual care, which included fall risk assessments, signage for high-risk patients, patient education, and manual documentation in patient records. The intervention units at each hospital tested the Falls Prevention Tool Kit, which was developed by the study team. This kit is a health information technology application that includes a risk assessment and tailored signage, patient education, and plan-of-care components. Adjusted fall rates in the intervention units (3.15 per 1000 patient days [CI, 2.54 to 3.90]) were lower than those of control units (4.18 per 1000 patient days [CI, 3.45 to 5.06]), yielding a rate difference of 1.03 (CI, 0.57 to 2.01). A particularly strong effect was found in patients aged 65 years or older (rate difference, 2.08 per 1000 patient days [CI, 0.61 to 3.56]).

In the second study, which we also judged to have low risk of bias, Ang and colleagues (20) randomly assigned patients in 8 medical wards of an acute care hospital in Singapore to a target intervention or usual care. An assessment tool was used to match high-risk patients with appropriate interventions, in addition to an educational session tailored to patient-specific risk factors, in the intervention group. Both groups received usual care, which included environmental modifications, review of medications and fall history, and generic fall prevention advice. The proportion of patients with at least 1 fall in the intervention group was 0.4% (CI, 0.2% to 1.1%), whereas in the control group it was 1.5% (CI, 0.9% to 2.6%), for a relative risk reduction of 0.29 (CI, 0.1 to 0.87).

One other study worth noting, by van Gaal and colleagues (39, 40), evaluated a program that targeted 3 patient safety practices (pressure ulcers, urinary tract infections, and fall prevention) simultaneously. They found an overall positive effect on development of any adverse event, a composite measure of pressure ulcers, urinary tract infections, and falls. The study was not powered to assess falls separately, but it is worth noting that the point estimate for the relative risk reduction in falls was 0.69, which is within the range of results reported in other studies and meta-analyses. The value of this study is the demonstration of simultaneous improvements in several safety intervention targets that may be relevant to the same patient population.

Harms

Most trials of fall prevention programs did not report any harms, although 1 reported constipation from intake of vitamin D (13). Whether trials explicitly assessed the possibility of harms was mostly unclear. Despite little empirical evidence, concern exists that some fall prevention interventions may lead to harms. For example, Oliver and colleagues (1) detailed many potential harms, including those that would result from increased use of restraints or sedating medications.

Implementation Considerations and Costs

Structural organizational characteristics, existing quality and safety infrastructure, patient safety culture, teamwork, and leadership are believed to be important contexts for understanding the effectiveness of fall prevention programs (41, 42).

tell and coworkers (43) and Gillies and colleagues (44) to analyze culture at the unit level, teamwork at both the organizational and unit levels, and leadership at the organizational and unit levels. Stenvall and colleagues (33) discussed teamwork at the unit level. Koh and coworkers (29) discussed leadership on the organizational and unit levels. van der Helm and colleagues (35) made several observations addressing leadership on both the organizational and unit levels.

Implementation

Implementation details are also considered to be important in understanding the effectiveness of fall prevention programs (41). The most commonly reported implementation details in the 21 studies were patient characteristics and the initial plan, or the intended intervention components. Some studies reported the intended roles of project staff, or by whom the intended intervention components were to be completed. Most studies reported the recipients of any training component, with slightly fewer reporting the type of training or giving a description of the training and even fewer studies reporting the length of training. Thus, the context and duration of training needed to implement fall prevention programs need better descriptions.

Several studies provided the materials used in program implementation, and some reported on adherence or fidelity to the designed initiative and how and why the plan evolved. Adherence or fidelity was most often characterized in a qualitative statement. According to Brandis (7): "The strategies implemented . . . had high acceptance by staff." Williams and colleagues (38) found staff involvement crucial to fidelity: "[I]nvolving ward staff . . . so that they take ownership of the project and do not perceive it as being driven by middle management were important strategies." Dykes and coworkers (24) provided a strong example of adherence reporting, in which protocol adherence was measured by completion of components in both control (81%) and intervention (94%) wards. Such quantitative data on protocol adherence should be encouraged in future evaluations of fall prevention programs. Measures of adoption and reach were usually provided in the form of a flow chart—6 studies presented these data for providers, and 8 presented the data for patients.

In addition to the studies previously discussed, we identified 11 studies that focused primarily on implementation. None were randomized, clinical trials and all studies had either pre–post or time-series designs. Six studies were poststudy evaluations of fall prevention implementations that reported detail about the potential reasons for effectiveness or lack thereof. Nine of the 11 studies assessed implementation at only 1 or 2 facilities. Four studies reported no beneficial effects of the fall prevention program and highlighted potential implementation factors that may account for the lack of success. One study explicitly assessed the effect of some contextual factors on intervention success across 34 facilities (described later) (45). One study explicitly assessed sustainability. From these 11 studies, we identified the following 7 themes about effective implementation: leadership support is critical, both at the facility level (for example, hospital director) and at the unit level (for example, unit director or "clinical champions"); engagement of front-line clinical staff in the design of the intervention helps ensure that it will mesh with existing clinical procedures; use of multidisciplinary committees is needed to guide or oversee the interventions; the intervention should be pilot-tested to help identify potential problems with implementation; information systems that are capable of providing data about falls can facilitate evaluation of the causes and adherence to the intervention components and potentially be a crucial facilitator of the intervention; changing the prevailing nihilistic attitude that falls are "inevitable" and that "nothing can be done" is required to get buy-in to the goals of the intervention (46, 47); and education and training of clinical staff are necessary to help ensure that adherence does not diminish. **Table 5** of the **Supplement** presents evidence from the 11 studies supporting each theme.

Costs

The Cochrane review found no economic evaluations of the fall prevention programs that met inclusion criteria (12). Oliver and colleagues (1) estimated the cost for specific combinations of components in terms of environment and equipment and in terms of staff; most costs were low or inconsequential.

The Effects of Context on Effectiveness

We identified only 1 study that explicitly assessed the effect of context on effectiveness (45). Across 34 Veterans Affairs health centers (a mix of acute care and long-term care facilities), leadership support was cited as one of the strongest factors for success. At 1-year follow-up, high-performing sites reported greater agreement with questions assessing leadership support, teamwork skills, and useful information systems than low-performing sites.

DISCUSSION

The evidence base indicates that inpatient multicomponent programs are effective at reducing falls and that consistent themes are associated with successful implementation. However, there is no strong evidence about which components are most important for success. The effects of context have not been well-studied; however, multicomponent interventions have been effective in hospitals that vary in size, location, and teaching status. The cost of implementing fall prevention programs has not been rigorously assessed but generally does not involve capital expenses or hiring new staff.

Our results about effectiveness are consistent with previous reviews on inpatient fall prevention programs. Our review additionally identifies 7 themes associated with suc-

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