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Inpatient Fall Prevention Programs as a Patient Safety Strategy

A Systematic Review

Isomi M. Miake-Lye, BA; Susanne Hempel, PhD; David A. Ganz, MD, PhD; and Paul G. Shekelle, MD, PhD

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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For author affiliations, see end of text.

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 injury 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.

See also:

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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

fall prevention in community-based settings were excluded. To identify relevant reviews, we used methods described by Whitlock and colleagues (10). See the **Supplement** for a complete description of the search strategies, evidence tables, and a literature flow diagram. These reviews were supplemented with the results of a search by Hempel and colleagues (11), which was done for a report that addressed prevention of inpatient falls. Hempel and coworkers used 16 existing reviews and reports to identify additional pertinent sources and searched PubMed, CINAHL, and the Web of Science for relevant literature not yet covered in reviews. The search included randomized, controlled trials; nonrandomized trials; and before-and-after studies in English-language publications that addressed falls in the acute care hospital setting. Searches were conducted from 2005 through September 2012.

Previous Studies and Reviews

The 4 systematic reviews are a 2008 review from the Cochrane Collaboration by Cameron and colleagues (12), a 2008 review by Coussement and coworkers (13), a review by Oliver and colleagues originally published in 2007 (14) and then updated in 2010 as a narrative review (1), and a 2012 review by DiBardino and colleagues (15). All 4 reviews scored well on the assessment of multiple systematic reviews (AMSTAR) criteria for systematic reviews (11 out of 11, 10 out of 11, 10 out of 11, and 8 out of 11, respectively), which evaluates such items as comprehensiveness of the search, assessment of the quality of included studies, and methods for synthesizing the results (16). The Cochrane review searched for randomized trials to assess the effectiveness of fall reduction interventions for older adults in nursing care facilities and hospitals (12). Of the 41 included trials, 11 were conducted in hospital settings, 4 of which addressed multicomponent interventions. The review by Coussement and coworkers identified 4 multicomponent studies, 2 of which were included in the Cochrane review (13). The review by Oliver and colleagues used broader inclusion criteria than the Cochrane review, which led to the inclusion of 43 trials, case–control studies, and observational cohort studies (14). Thirteen of these studies were classified as multicomponent inpatient interventions. Oliver and coworkers' updated narrative review focused directly on hospital fall prevention and discussed 17 multicomponent studies spanning from 1999 to 2009, which include the 6 trials in the Cochrane and Coussement and colleagues' reviews (1, 13). The recent review by DiBardino and coworkers (15) identified 6 primary research studies in the acute care inpatient setting, 3 of which were included in the Oliver and colleagues' 2010 update.

Supplemental Search

Our supplemental search started with studies identified by Hempel and coworkers, focusing on individual and cluster randomized, controlled trials with large sample sizes that assessed multicomponent interventions in acute care hospitals, in the general population or older adult population. We were looking for "pivotal studies," defined by Shojania and colleagues (17) as trials that may call into question the results of an existing review. Studies were screened by a clinician and nonclinician, each of whom was experienced in systematic reviews. This search identified 2 new relevant studies, both of which showed statistically significant improvements in intervention groups when compared with control groups and which we discuss briefly later. We also describe a third study because of its unique design. Because Oliver and coworkers' 2010 update used Downs and Black (18) to assess the quality of individual studies, we did the same for the 2 new studies. We assessed the strength of evidence across studies using a framework developed for the Agency for Healthcare Research and Quality patient safety review (19). To identify studies in which a principal goal was reporting on implementation, we surveyed the results of our updated search and queried experts for additional studies.

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Key Summary Points

The rate of falls in acute care hospitals ranges from approximately 1 to 9 per 1000 bed-days.

High-quality evidence shows that multicomponent interventions can reduce risk for in-hospital falls by as much as 30%.

The optimal bundle of components is not established, but common components include risk assessments for patients, patient and staff education, bedside signs and wristband alerts, footwear advice, scheduled and supervised toileting, and a medication review.

Harms of multicomponent interventions are unclear because they have not been studied systematically, but they may include the potential for increased use of restraints and sedating drugs and decreased efforts to mobilize patients.

Evidence about successful implementation of multicomponent interventions suggests that the following are important factors: leadership support, engagement of front-line clinical staff in the design of the intervention, guidance by a multidisciplinary committee, pilot-testing the intervention, and changing nihilistic attitudes about falls.

Benefits and Harms

Benefits

Table 2 presents details about the 21 effectiveness studies included in previous reviews or our updated search.

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).

Table 2. **Abridged Evidence Tables***

Study, Year (Reference)	Study Design	Setting	Participants	Quality Score†	Outcome
Ang et al, 2011 (20)‡	*RCT*	*8 medical wards; acute care; Singapore*	*1822 patients*	*25*	*Significantly fewer falls*
Barker et al, 2009 (21)	Before-and-after	Small; acute care; Australia	271 095 patients	16	Significantly fewer injuries
Barry et al, 2001 (22)	Before-and-after	Small; long-stay and rehabilitation; Ireland	All patients admitted to 95 beds for 3 y	15	Significantly fewer injuries
Brandis, 1999 (7)	Before-and-after	Acute; Australia	All patients admitted to 500 beds for 2 y	11	Nonsignificantly fewer falls
Cumming et al, 2008 (23)	Cluster RCT	24 wards; acute and rehabilitation; Australia	3999 patients	27	Nonsignificantly fewer falls
Dykes et al, 2010 (24)‡	*Cluster RCT*	*8 units; medical; urban United States*	*All patients admitted or transferred to units over 6-mo study period*	*27*	*Significantly fewer falls*
Fonda et al, 2006 (25)	Before-and-after	4 wards; elderly acute and rehabilitation; Australia	3961 patients	20	Significantly fewer falls
Grenier-Sennelier et al, 2002 (26)	Before-and-after	400 beds; rehabilitation; France	All admitted patients over 4 y	11	Significantly fewer falls
Haines et al, 2004 (27)	RCT	3 wards; subacute, rehabilitation, and elderly; Australia	626 patients	26	Significantly fewer falls
Healey et al, 2004 (28)	Cluster RCT	8 wards; acute and rehabilitation; 3 hospitals; United Kingdom	3386 patients	26	Nonsignificantly fewer falls
Koh et al, 2009 (29)	Cluster RCT	2 hospitals; acute; Singapore	All admissions over 1.5 y	14	Nonsignificantly fewer falls
Krauss et al, 2008 (30)	Before-and-after	General medicine; acute academic hospital; United States	All admissions over 18 mo	18	Nonsignificantly fewer falls
Mitchell and Jones, 1996 (31)	Before-and-after	1 acute and 1 subacute ward; 32 beds; Australia	All patients admitted to 32 beds for 6 mo	16	Nonsignificantly fewer falls
Oliver et al, 2002 (32)	Before-and-after	Elderly medical unit; acute hospital; United Kingdom	3200 patients admitted annually; data over 2 y	8	Nonsignificantly greater falls
Schwendimann et al, 2006 (6)	Before-and-after	300 beds; internal medical, geriatric, and surgical; Switzerland	34 972 admissions	15	Nonsignificantly fewer falls
Stenvall et al, 2007 (33)	RCT	3 wards; orthogeriatric, geriatric, orthopedic; Sweden	199 patients	25	Significantly fewer falls
Udén et al, 1999 (34)	Before-and-after	Geriatric department; acute hospital; Sweden	379 patients	12	Nonsignificantly greater falls
van der Helm et al, 2006 (35)	Before-and-after	Internal medical and neurology wards; acute hospital; the Netherlands	2670 patients	11	Nonsignificantly greater falls
Vassallo et al, 2004 (36)	Cohort	3 wards; rehabilitation; United Kingdom	825 patients	25	Nonsignificantly fewer falls
von Renteln-Kruse and Krause, 2007 (37)	Before-and-after	Elderly acute and rehabilitation wards; Germany	7254 patients	17	Significantly fewer falls
Williams et al, 2007 (38)	Before-and-after	3 medical wards and 1 geriatric unit; Australia	1357 admitted patients during 6-mo intervention	17	Significantly fewer falls

RCT = randomized, controlled trial.
* From reference 1.
† Downs and Black Quality Score (18), evaluated by Oliver and colleagues (1)—except for entries in italics, which were evaluated by Ms. Miake-Lye and Dr. Shekelle.
‡ New studies added from updated search.

Structural Organizational Characteristics

Studies evaluating fall prevention programs were done in various geographic areas and settings, including the United States, Australia, the United Kingdom, Sweden, Singapore, France, Switzerland, the Netherlands, and Germany (see **Table 3** of the **Supplement**). Several were conducted in an academically affiliated or teaching hospital. Sizes of hospitals varied from small (fewer than 100 beds) to large (greater than 500). Some studies encompassed several hospitals (for example, 4), and others involved multiple wards. These data show that fall prevention programs have been implemented in hospitals of varying size, location, and academic or teaching status. No studies reported on financial concerns (for example, how patient care or the interventions were financed), although 1 U.S. study mentioned the potential effect of reimbursement on the emphasis on fall prevention (24).

Existing Infrastructure

Existing organizational infrastructure was described rarely, with only 5 of the 21 studies describing this for their settings. In 4 studies, this description was limited to their usual fall prevention care. The fifth study provided a more explicit statement, namely, "prior to this study none of the wards carried out specific fall assessments or interventions . . . there was no specialist falls clinic or other falls service available at this hospital" (28). Two studies reported on the presence or absence of information systems that could be used in fall prevention programs (24, 26).

Patient Safety Culture, Teamwork, and Leadership

Although some studies briefly mentioned patient safety culture, teamwork, or leadership, only 4 studies presented expanded explanations of those factors. Grenier-Sennelier and colleagues (26) used a framework from Shor-

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-

cessful implementation. Some themes, such as education or training and leadership support, are often included in general lists of factors for successful implementation of any intervention, whereas themes that may be more specific to fall prevention programs include development and guidance by a multidisciplinary committee and changing the prevailing attitudes of nihilism with respect to falls.

Our findings that multicomponent fall prevention programs are effective in inpatient settings may seem at odds with recent U.S. Preventive Services Task Force recommendations not to automatically do a multifactorial fall assessment in community-dwelling adults aged 65 years or older (48). However, there is no contradiction because, although the goal is to prevent falls in both community-dwelling and hospitalized patients, the settings are different. The hospital environment is more tightly controlled than the outpatient setting, where it is more difficult to ensure that risk factors for falls are appropriately managed. In fact, as Tinetti and Brach (49) note, community-based multifactorial programs achieve greater reduction in falls when identified risk factors are actually managed.

Our review has several limitations. Like all reviews, we are limited by the quality and quantity of the original research articles. Also, we did not do an exhaustive update of existing reviews. With several previous reviews reaching consistent results, including a total of 19 effectiveness studies, we focused instead on identifying "pivotal studies" that may call into question the conclusions of previous reviews. None were found; additional large randomized, controlled trials supported the conclusions of existing reviews. Our assessment of implementation themes is novel and deserves prospective evaluation (for example, one that could measure the degree of leadership support or staff attitudes about fall prevention before and during an intervention).

For multicomponent inpatient fall programs, our review provides both evidence that such programs reduce falls and insight into how facilities can successfully implement them. Future research would most effectively advance the field by determining whether an "optimal" bundle of components exists or whether effectiveness is primarily a function of successful implementation.

From the Veterans Affairs Greater Los Angeles Healthcare System and David Geffen School of Medicine at the University of California, Los Angeles, Los Angeles, and the RAND Corporation, Santa Monica, California.

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Requests for Single Reprints: Paul G. Shekelle, MD, PhD, RAND Corporation, 1776 Main Street, Santa Monica, CA 90401; e-mail, shekelle@rand.org.

Current author addresses and author contributions are available at www.annals.org.

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Current Author Addresses: Ms. Miake-Lye and Drs. Ganz and Shekelle:
Veterans Affairs Greater Los Angeles Healthcare System, 11301 Wilshire Boulevard, Los Angeles, CA 90073.
Dr. Hempel: RAND Corporation, 1776 Main Street, Santa Monica, CA 90401.

Author Contributions: Conception and design: P.G. Shekelle.
Analysis and interpretation of the data: I.M. Miake-Lye, S. Hempel, D.A. Ganz, P.G. Shekelle.
Drafting of the article: I.M. Miake-Lye, P.G. Shekelle.
Critical revision of the article for important intellectual content: I.M. Miake-Lye, S. Hempel, D.A. Ganz, P.G. Shekelle.
Final approval of the article: I.M. Miake-Lye, S. Hempel, D.A. Ganz, P.G. Shekelle.
Provision of study materials or patients: P.G. Shekelle.
Obtaining of funding: P.G. Shekelle.
Administrative, technical, or logistic support: I.M. Miake-Lye, P.G. Shekelle.
Collection and assembly of data: I.M. Miake-Lye, S. Hempel, P.G. Shekelle.

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