Reducing the Risk of Falls and Fall-related Injuries among Older People

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Abstract

This paper reviews approaches to preventing falls in older adults at the individual, community and national levels. We find extensive evidence to support fall prevention at the individual level, with exercise programs and multifactorial evaluation and intervention showing the most promise. Good data also exist to support community-level fall prevention strategies, and several national fall-prevention programs are ongoing. Officials in countries implementing fall-prevention programs should monitor their efforts for effectiveness and sustainability, so that program design can be improved based on sound evidence, and so that results and lessons may provide guidance for other countries. Over the long term, only activated communities will be able to achieve the full benefit of the fall prevention strategies that we have reviewed.

INTRODUCTION

About one-quarter of community-dwelling older adults fall every year (Ganz, Bao, et al., 2007), resulting in annual medical care costs of at least $19 billion in the United States alone (Stevens, Corso, et al., 2006). While most falls do not result in injury, 5-10% of falls cause serious injuries such as major head trauma, major lacerations, or fracture (Rubenstein and Josephson, 2002). Frequent falls predict nursing home placement (Tinetti and Williams, 1997), and may cause older adults to restrict their daily activities. Over the past twenty-five years, evidence from basic epidemiologic research and studies on the mechanics of gait and balance have led to successful randomized, controlled trials of exercise programs and individually tailored multifactorial interventions to prevent falls (Chang, Morton, et al., 2004). This “bench-to-bedside” phase of research represents the first step in translational research: moving from basic research to successfully implemented randomized trials. The research community must now address a second, equally important phase of translational research: moving from randomized, controlled trial evidence to implementation in communities and health systems. Without implementation of research evidence into practice, the full benefit of earlier research efforts will not accrue to older adults.

Fall prevention efforts offer one approach to reducing health disparities both among older adults, and also between older adults and the rest of the population. Older adults’ ability to participate meaningfully in society depends heavily on their ability to remain independent, and falls are often a precursor to a downward slide that results in a loss of independence, particularly if a serious injury occurs. Therefore, falls prevention efforts have important consequences not just medically, but socially.

Worldwide, policymakers have made notable efforts to initiate fall prevention programs at the individual, community and national levels. This report will detail the evidence in support of fall prevention strategies at all three of these levels. We will briefly summarize the well-developed literature on best practices for fall prevention at the individual level, and then move towards the evidence in support of community-level and national interventions to prevent falls. We will also discuss current barriers to implementation of fall prevention programs, and suggest options for how these barriers might be overcome. However, we first provide statistics on the scope of the problem and a conceptual framework to draw solutions.

FALLS AS A MEDICAL AND PUBLIC HEALTH PROBLEM

Falls may be defined, for research purposes, as "an unexpected event in which the participants come to rest on the ground, floor, or lower level (Lamb, Jorstad-Stein, et al., 2005)." Falls are the most common mechanism of injury (62%) for an estimated 2.7 million nonfatal injuries among those 65 and older treated in United States emergency departments in 2001 (Centers for Disease Control and Prevention, 2003), indicating that falls are a serious medical and public health problem. Since not all injurious falls result in a visit to the Emergency Department, the true magnitude of the problem is likely much larger.

Falls are also costly (Englander, Hodson, et al., 1996; Carroll, Slattum, et al., 2005; Stevens, Corso, et al., 2006). The most recent study from the National Center for Injury Prevention and Control estimated the cost of fall injuries in the United States at over $19 billion for the year 2000 (Stevens, Corso, et al., 2006). In one study, total annual healthcare costs of patients with injurious falls were $19,440 higher (in 1996 U.S. dollars) than for patients who did not fall (Rizzo, Friedkin, et al., 1998).

Conceptual Framework

Although falls are acute events, the underlying risk factors for falls are chronic problems, some of which are malleable through a combination of community-level and health system supports. The Chronic Care Model proposes that changes in the organization of health care, including linkage to community resources, together with changes in care processes, will lead to better functional and clinical outcomes for patients with chronic illnesses (Wagner, 1998). This model provides an important conceptual basis for fall prevention efforts.

Building on information from the MacColl Institute, which developed the Chronic Care Model, and an extensive literature review and expert consultation, Pearson and colleagues list a set of intervention strategies around the following six key domains of the model (Pearson, Wu, et al., 2005):

- delivery system redesign (changes in the organization of care delivery),

- self-management support strategies (efforts to increase patients' involvement in their own care),
- decision support (guidelines, education, and expertise to inform care decisions),
- information systems (changes to facilitate use of information about patients, their care, and their outcomes),
- community linkages (activities increasing community involvement), and
- health system support (leadership, practitioner, and financial support).

A recent meta-analysis suggests that interventions with at least one Chronic Care Model element are likely to have a clinically beneficial effect across different chronic conditions (Tsai, Morton, et al., 2005), lending validity to the model framework.

The virtue of the Chronic Care Model is its ability to link ongoing activities to prevent falls at the individual level (e.g., in a physician's office) to community-based strategies that an at-risk individual may tap into for support when needed.

Understanding the ecology of fall risk factors is critical in conceptualizing fall prevention efforts. As we will discuss below, multiple risk factors unique to the individual may interact with environmental hazards to produce falls. However, there are different types of environmental hazards, some of which occur within an elder's home (such as a loose electrical cord) and others of which occur in public spaces (such as uneven pavement). Thus, effective fall prevention policies will address fall risk both through efforts that ultimately result in changes in individual behavior (whether of health care providers or at-risk individuals), as well as more diffuse changes that affect the physical environment.

EVIDENCE THAT FALLS CAN BE PREVENTED

Individual-Level Interventions

For falls and mobility disorders, most of the evidence supporting clinical guidelines comes from individual-level interventions. We define individual-level interventions as programs whose effect is mediated through provision of an intervention strategy directly to an identifiable set of individuals. From a recent meta-analysis we know that of these interventions, patient education alone or environmental modifications alone are not likely to be effective at preventing falls (Chang, Morton, et al., 2004). However, exercise is effective, as are multifactorial interventions (Chang, Morton, et al., 2004).

Exercise

Exercise interventions have been studied in the largest number of randomized, controlled trials in the fall-prevention literature. Interventions differ in the mode of delivery (group-based or individual-based), setting (medical setting, community, or home), and type of providers (nurses, physical or occupational therapists, physical activity instructors). Many different types of exercise interventions have been developed, ranging from general activities (e.g., walking, cycling, aerobic movements, and Tai Chi) to specific physical activity (e.g., targeted training to improve balance, gait, and strength).

Evidence from a meta-analysis has suggested that exercise interventions reduce the risk of falling (relative risk (RR), 0.86, 95% C.I. 0.75-0.99) and the monthly fall rate (incidence rate ratio (IRR), 0.84, 95% C.I. 0.73-1.01) (Chang, Morton, et al., 2004). Among the different types of exercise, this analysis did not find significant difference in efficacy among exercise oriented towards improve balance, endurance, flexibility, or strength. A different systematic review showed that an individually tailored home muscle strengthening and balance retraining program prescribed by a trained health professional is an effective intervention in reducing risk of falling (pooled RR 0.80, 95% C.I. 0.66 - 0.98) (Gillespie, Gillespie, et al., 2003). The review suggests that another intervention likely to be effective is a 15 week Tai Chi group exercise program (1 trial with 200 participants, RR 0.51. 95% CI 0.36-0.73) (Gillespie, Gillespie et al. 2003). However, brisk walking alone was not sufficient to help women with a recent (within 2 years) upper limb fracture reduce fall risk (Gillespie, Gillespie, et al., 2003).

Compelling evidence supports exercise interventions, or multifactorial interventions that include exercise as a core component, as significantly reducing the risk of future falls in older adults. Moreover, by virtue of increasing bone mineral density (Bonaiuti, Shea, et al., 2002), exercise may decrease the percent of falls that result in fractures. However, the optimal intensity, locale, delivery methods, and exercise types have yet to be determined, and may need to be customized to fit individuals' preferences.

Multifactorial Interventions

Evidence from a meta-analysis of randomized trials suggests that multifactorial interventions to prevent falls are effective, reducing the fall rate by approximately 12 falls/100 person-months, or about 30-40% in relative terms (Chang, Morton. et al.. 2004). A separate meta-analysis has shown that multifactorial interventions are effective in both unselected elders and those at high risk of falls (Gillespie, Gillespie. et al. .2003). A typical intervention begins with a multifactorial fall risk assessment. Although studies differ in what constitutes a multifactorial fall risk assessment, seven components are common to most multifactorial interventions:

- orthostatic blood pressure measurement
- vision assessment
- gait and balance evaluation
- assessment of basic and instrumental activities of daily living
- cognitive evaluation
- medication review, and
- assessment of environmental hazards (Chang, Morton et al. 2004).

The premise behind the multifactorial assessment is that multiple interacting causes lead to a fall. If there is a persistent blood pressure drop when moving from the horizontal to the standing position, this drop may lead to dizziness or balance problems, contributing to a fall. If vision is poor, individuals may not detect hazards that could lead to a fall. If gait or balance is abnormal, tripping or falling is more likely. If individuals have limitations in their ability to perform basic activities, such as bathing, or instrumental activities, such as preparing meals, they may overreach their abilities physically, leading to an accidental fall. Poor cognition may lead to poor insight and judgment about what activities can be accomplished safely. Medications, particularly those active in the central nervous system, may cause confusion or drowsiness, leading to poor detection of environmental hazards. And environmental hazards themselves increase the likelihood of falling.

Because different individuals have different risk factors for falling, the goal of the multifactorial risk assessment is to develop individually tailored interventions that address an individual's risk factor profile. For example, if an older adult has a balance problem, a physical therapist may work with her to improve postural stability with appropriate exercises, and may also recommend an assistive device such as a walker to improve stability. An occupational therapist may visit the elder's home to identify environmental hazards such as electrical cords or throw rugs that may increase the risk of falls. If an elder has functional impairments, the occupational therapist may recommend outfitting the home with adaptive equipment (bedside commode, grab bars) to improve an elder's ability to perform activities of daily living and thereby decrease fall risk. A physician may review the individual's medications and see whether medicines that increase fall risk, such as benzodiazepines, may be appropriately tapered or discontinued.

Clinical practice guidelines suggest that multifactorial fall interventions be reserved for individuals with a history of recurrent falls, a fall requiring medical attention, or an abnormality of gait and/or balance (American Geriatrics Society, 2001; National Institute for Clinical Excellence, 2004), based on the premise that the intensity of intervention should be calibrated to the patient's risk (American Geriatrics Society, 2001). A cost-effectiveness analysis comparing a multifactorial intervention for falls to usual care supports this premise, finding that the intervention had a lower cost per fall prevented in higher-risk, compared to lower-risk, individuals (Rizzo, Baker, et al., 1996). However, the appropriate method of screening for fall risk, and the risk threshold above which individuals should receive a multifactorial assessment has not been empirically determined in randomized trials.

Organizational Aspects of Individual-Level Interventions

An evidence report prepared by RAND for the U.S. Department of Health and Human Services found no evidence that fall interventions need be provided by a particular type of provider (e.g., occupational therapist), or in a particular setting (medical vs. non-medical) (Shekelle, Rubenstein, et al., 2003). Types of providers involved in interventions included physicians, nurse practitioners, nurse educators, nurses, physical or occupational therapists, and physical activity instructors.

Barriers to translating individual-level multifactorial programs into practice from a medical perspective

Although Medicare, the primary insurer for the vast majority of older adults in the United States, does not have a formal fall prevention benefit, Medicare generally covers all of the components of the multifactorial fall risk assessment process, including outpatient medical visits, physical therapy (either as an outpatient or at home) and a home safety evaluation, as well as any tests ordered by the physician (within the standard of care) to evaluate fall risk factors (United States Center for Medicare and Medicaid Services.). However, to be reimbursed by Medicare, multfactorial risk assessment must be coded as treating a given problem (e.g., gait impairment) rather than as preventive care (Tinetti, Gordon, et al., 2006).

Medicare's coverage for intervention on risk factors discovered by multifactorial assessment is more variable. For example, the intensity of physical therapy covered by Medicare is unlikely to be equivalent to that offered in randomized, controlled trials of group or individual exercise regimens. In addition, although a home safety evaluation may yield important areas for home improvement (such as fitting a shower with grab bars), Medicare itself does not cover all the supplies that may be deemed necessary to make the home safe; in particular, there is generally no coverage of home improvements (such as grab bars and ramps) that might decrease the risk of falls.

Falls have traditionally not been viewed as a medical problem, although injuries subsequent to a fall are more naturally a medical concern. Thus, it is not surprising that physicians perform poorly on expert-panel approved measures of recommended care processes for patients with falls and mobility disorders, substantially more so than for general medical conditions like diabetes and hypertension (Wenger, Solomon, et al., 2003). Vulnerable elders with falls and mobility disorders received only 34% of recommended care for their condition in one community study (Wenger, Solomon, et al., 2003). For example, only 10% of patients had a documented gait and balance examination in the medical record subsequent to a fall (Rubenstein, Solomon, et al., 2004).

The difficulties that clinicians face in caring for patients with falls are part of a larger problem of adhering to clinical guidelines for any condition. Cabana has grouped barriers to adherence to clinical guidelines into three types: knowledge, attitudes, and behavior (Cabana, Rand, et al., 1999). For example, one knowledge barrier to appropriate care for falls is that clinicians may be unaware that falls are preventable (Baker, King, et al., 2005). An attitude barrier would be that fall evaluation includes factors that have not traditionally been considered "medical," such as an assessment of activities of daily living, or an evaluation of safety in the home; in other words, physicians have not been trained to see a fall evaluation as part of their standard repertoire of activities they are expected to perform in the office (Baker, King, et al., 2005). Behavioral barriers to optimal care for falls are multitudinous, including external factors such as time constraints, patients not reporting a recent fall (Chou, Tinetti, et al., 2006), patients having multiple competing problems for the clinicians to address (Jaen, Stange, et al., 1994), and lack of clinical reminders or decision support to prompt the clinician to perform the appropriate evaluation.

Delivery system redesign to overcome barriers to individual-level interventions

Berwick has suggested that redesign of clinical microsystems (small units of care such as an office practice or a hospital ward) can enhance care to the individual (Berwick, 2002). The evidence for the effectiveness of redesigning care for falls and mobility disorders at the clinical microsystem level comes from studies such as the Assessing Care of Vulnerable Elders-2 (ACOVE-2) study (Wenger, Roth, et al., 2005), and more information is expected within the next year from the American College of Physicians – RAND Practice Redesign for Improved Medical Care for Elders (PRIME) study (Hall, 2006).

The rationale for the ACOVE-2 project was to act on the original findings of the ACOVE project that the quality of care for vulnerable elders with geriatric conditions was particularly poor (Wenger, Solomon, et al., 2003). The ACOVE-2 intervention was designed to improve the quality of care for falls, incontinence, and cognitive impairment in a group of community-dwelling adults age 75 and older screening positive for at least one of these conditions (Reuben, Roth, et al., 2003). The ACOVE-2 intervention consisted of case-finding followed by a multi-component restructuring of care delivery consistent with the Chronic Care Model (Wagner, 1998). First, patients were screened for target conditions: clinic staff placed telephone calls to all patients age 75 years and older about one week prior to a scheduled office visit, in consecutive order according to clinic appointment date. In the second step, clinicians whose patients screened positive for one of the three target conditions received a condition-specific structured visit form that was placed on the medical record, along with information on which conditions the patient had screened positive. This structured visit form, which could serve as the visit note, guided the physician to consider potentially important elements of the history and physical examination. The note also helped the clinician develop a plan by suggesting diagnostic tests and treatments, and by enabling automatic orders for simple procedures (e.g., obtaining orthostatic blood pressures, or urinalysis and culture) to be completed by the nurse or medical assistant. More than any other component of the intervention, the use of structured visit notes for specific target conditions might be expected to result in physicians following a standardized, comprehensive approach to managing these conditions. Patient education materials were available in each examination room to support the clinician's plan and patients' self-care. Clinicians also participated in a 3-hour educational program that taught an efficient approach to each of the target conditions.

The ACOVE-2 practice redesign intervention demonstrated an improved quality of care for falls and mobility disorders, compared to control practices where only the screening for target conditions was performed, without the multi-component intervention. The percent of recommended falls care processes performed in the intervention practices was 44%, compared to 23% in the control practices ($p<0.001$) (Wenger, Roth, et al., 2005). In addition, the ACOVE-2 intervention did not cause a deterioration in quality of care for 9 other conditions that were not targeted for intervention (Ganz, Wenger, et al., 2007). This work suggests that quality improvement efforts for falls and mobility disorders at the clinical microsystem level can be implemented safely and with net benefit to the patient.

An alternative to redesigning care in primary care practices to provide care for patients at risk for falls is to establish a falls clinic to which primary care practitioners may refer patients (Hill, Dwyer, et al., 1994; Beer, 2006; Perell, Manzano, et al., 2006). Thus far data are too sparse to draw conclusions about effectiveness of this approach.

Evidence for efficacy of falls prevention at the community-wide level

We define community-level interventions as programs that operate diffusely through community mobilization to achieve a particular outcome. In contrast to individual-level interventions, the primary target of community-level interventions is the community as a whole, and the people benefiting from the intervention are not individually identifiable, even though individual-level data may be collected to measure the effectiveness of the intervention on a community.

Evidence for effectiveness of strategies to prevent falls at the community-wide level comes from a recent Cochrane meta-analysis of five controlled before-after studies (McClure, Turner, et al., 2005). Because the community was the unit of analysis, randomization was not feasible in these studies. The largest of the five studies targeted 80,000 individuals age 60 and older in the intervention community (Kempton, van Beurden, et al., 2000). Studies took place in Australia, Denmark, Norway, and Sweden. Intervention components universally included community mobilization and education, as well as attempts to reduce environmental hazards, particularly in elders' homes, but sometimes in public spaces as well. Additionally, some interventions included group exercise programs and attempts to address medical risk factors, such as medications, vision, or gait and balance. Across all five studies, fall-related injuries decreased anywhere from 6 to 33% on a relative basis (McClure, Turner, et al., 2005).

The program with the most thorough description in the published literature is the Australian "Stay on Your Feet" program, which underwent a detailed evaluation. In addition to using administrative data on fall-related hospitalizations to establish intervention effects, the "Stay on Your Feet" evaluators documented rates of self-reported falls in a randomly selected sample of intervention and control participants, and found that the relative reduction in fall rates, although not statistically significant, was consistent with the relative reduction in fall-related hospitalizations (Kempton, van Beurden, et al., 2000). Data from this study allow calculation of the absolute reduction in falls per 100 person-months, facilitating comparison with the individual-level interventions discussed earlier (see Table 1). Sustainability of the “Stay on Your Feet” program was assessed five years post-intervention, and demonstrated generally positive evidence of changed practices among health professionals and older people themselves (Barnett, Van Beurden, et al., 2004). However, local government did not sustain any activities (Barnett, Van Beurden, et al., 2004).

In the United States, the Connecticut Collaboration for Fall Prevention (CCFP)(Fortinsky, Iannuzzi-Sucich, et al., 2004; Baker, King, et al., 2005; Brown, Gottschalk, et al., 2005; Chou, Tinetti, et al., 2006) is a notable example of work to overcome barriers to fall risk assessment and management at the large organization and community-wide level, but an evaluation of this project has not yet been published.

NATIONWIDE STRATEGIES FOR FALL PREVENTION

In recent years, several examples of national or regional fall prevention programs to reduce the risk of falling have emerged. Below we discuss the programs conducted in New Zealand, Canada and Europe.

Falls are the leading cause of injury hospitalization in New Zealand, a country of about 4 million people. “Preventing Injury from Falls: the National Strategy 2005-2015” is a ten-year project focused on reducing incidence and severity of injury from falls, and reducing the social, psychological and economic impact of fall-related injuries (Dyson, 2005). This strategy is part of a larger effort to reduce accidental injuries, and calls for governmental, organizational, academic and individual collaborations not only at the national level, but also at the local and regional level. The following principles guide fall prevention activities in this strategy: a lead role for government; collective action; personal skills and responsibilities; improving environments; equity; evidence-based decision making; effectiveness; integration; anticipating and responding to change; and appropriateness. Interventions include leadership building in fall prevention; education and dissemination; best practice; environmental modification; and resource reallocation. The implementation of New Zealand fall prevention strategy involves three main phases: establishment of strategy support frameworks from 2005 to 2006; full implementation from 2006 to 2010; and consolidation and looking to the future from 2010 to 2015.

The New Zealand fall prevention implementation plan is now available (Dyson, 2006), and includes both older adults and children as priority groups. The plan has five objectives (quoted verbatim):

1. Build effective leadership and co-ordination in the prevention of injury from falls
2. Improve the gathering and dissemination of knowledge about the prevention of injury from falls
3. Develop and implement programmes and interventions that focus on the prevention of injury from falls, based on best practice
4. Create safer environments to prevent injury from falls

5. Ensure appropriate resource levels for the prevention of injury from falls

The New Zealand implementation plan appropriately recognizes the need for programs that focus on individuals (objective 3), but also the need to work on environmental factors that present risks to the community at large (objective 4). The plan calls for an independent evaluation in June 2010.

Prevention of Falls Network Europe (ProFaNE) is a collaborative project to increase knowledge and capacity to reduce falls among elderly, by the implementation of evidence-based interventions (www.profane.eu.org). This strategy consists of four packages: taxonomy and classification; clinical assessment and management; assessment of balance function; and psychological aspects of falling. The network is funded by the European Commission. The collaboration of clinicians, public, and researchers will identify major gaps in knowledge of fall injury prevention and facilitate large-scale clinical research activity, including clinical trials, core-dataset identification, balance assessment and prospective meta-analysis. Work is being undertaken in a 48 month project that commenced in January 2003.

A community-based health promotion initiative in Canada aiming to help identify effective fall prevention strategies for veterans, seniors, and healthcare providers was launched under the National Falls Prevention Initiative funded by Veterans Affairs in partnership with Health Canada. Pilot studies have been conducted at the national level and in three regions: Atlantic Canada, British Columbia, and Ontario. The program comprises three phases: development of an inventory of existing fall programs, identification of best practices in falls prevention, and evaluation of intervention programs.

"Watch Your Step" is a one of the pilot projects in this initiative, focused on fall education, information dissemination, public awareness promotion among isolated seniors, active seniors, veterans, and caregivers. This project began in May 2001 and ended in March 2004. Approximately two thousand seniors participated in community workshops, and several thousand people received information on fall risks and fall prevention.

Prerequisites to achieving effective community-level and national-level falls prevention programs

In an influential book that changed the discourse on public policy, John Kingdon wrote about the conditions required to achieve sustained policy change (Kingdon, 2003). He hypothesized that there are three streams of activity that converge into a "policy window" in which policies can be enacted. These three streams are the problem stream, the policy stream, and the political stream. In essence, there need to be convincing data that a particular policy issue is a worsening problem (such as increased fall or injury rates over time), a viable policy solution needs to be available at the time of this problem, and political conditions (the particular elected officials in power and the views of the electorate) need to be ripe for a policy change. Without the confluence of these factors, a policy window is unlikely to occur.

Below, we propose a policy solution to achieve a national-level fall prevention strategy in the United States. We recognize, however, that further work needs to occur in the problem stream in terms of developing better indicators of national fall rates (since not all falls come to medical attention or result in a hospitalization), as well as substantial political change, before national policy adoption is conceivable. Indeed, adopting an effective national fall prevention program will require a political culture that envisions health as more than the absence of disease, but as a physical and mental state that allows individuals to function effectively and independently in society.

A nationwide fall prevention strategy: the United States as an example

Any nationwide strategy for fall prevention should promote physical activity for all older adults who are capable of it. However, this health promotion goal remains a long-term rather than short-term strategy for improving health. Physical activity for seniors is already available through a variety of community resources, including commercial gyms, YMCAs, senior centers, community centers, parks and recreation facilities, churches, and hospitals/clinics (Hughes, Williams, et al., 2005). Yet in one study, only 4% of sites that offer senior exercise programs have waiting lists (Hughes, Williams, et al., 2005). Thus, public policy aimed at amplifying the availability of resources for group physical activity may not be desirable at this time. However, creating ways to link older adults with desired exercise classes, perhaps through the use of a national hotline, would potentially be a reasonable investment of resources. This idea of creating linkage to community resources is in keeping with the Chronic Care Model (Wagner, 1998).

Of note, not all older adults desire group exercise programs; in one study, a majority of middle-aged and older women preferred to exercise on their own (King, Castro, et al., 2000). Particularly for those who like to walk for exercise, a conducive physical environment with pleasant surroundings, or desirable destinations to walk to, may encourage walking (Berke, Koepsell, et al., 2007). Architecture and urban planning may play an important role, in the long term, in reshaping neighborhoods and buildings to encourage physical activity, combined with traditional public education on the importance of physical activity for health.

Earlier in this report, we reviewed the evidence supporting community-level interventions to decrease falls (McClure, Turner, et al., 2005). The most significant limitation of these studies is that they were all conducted in small communities, the largest of which had 80,000 adults age 60 and older and was in a rural area (Kempton, van Beurden, et al., 2000). The high level of motivation required for local community mobilization makes this strategy difficult to implement in a nationwide rollout, unless significant resources are invested into a population health infrastructure to coordinate such activities.

In the shorter term, providing coverage for exercise classes as a free health benefit for older people is an attractive policy option. In the United States, Group Health Cooperative of Puget Sound (among other managed care organizations) already provides this option for its Medicare enrollees (Group Health Cooperative, 2007), and observational studies (admittedly with substantial methodological limitations) provide some support of lower healthcare costs among those who exercise (Ackermann, Cheadle, et al., 2003; Nguyen, Ackermann, et al., 2007). Although adding this benefit to standard fee-for-service Medicare (in which the vast majority of older adults are enrolled) would require Congressional legislation, such an approach would take advantage of a payment system that is already in place, and which has gradually expanded in scope in the past to cover other preventive services such as influenza vaccinations. Creating such a benefit, however, would require some means of certifying that programs meet certain minimum standards and maintain fidelity to approaches that were successful at preventing falls in randomized trials.

An additional problem with Medicare covered services currently is that components of the multifactorial fall assessment are covered, but interventions to safeguard the home are not fully covered. If other policy changes could be mobilized (e.g., providing tax benefits to seniors to improve home safety) to support adoption of home modifications recommended by an occupational therapist as part of a home safety evaluation (such as ramps, grab bars, and the like), the value of the home safety evaluation would be substantially enhanced.

In the long run, however, simply adding benefits to the Medicare program is unlikely to result in a sustained reduction in falls and injuries, because it can only address the problem of falls at an individual level. As we have already seen, some aspects of fall prevention are beyond any one individual's control, such as the walkability of a neighborhood. Concerted community action will be necessary, both to increase public awareness and thus receptivity to fall prevention efforts, and to target factors that are not amenable to individual level intervention, such as fixing hazards in public spaces (e.g., broken pavement). Community mobilization in turn requires dedicated leadership, as well as time and financial resources, which are unlikely to arise without support from higher levels (state and federal governments). Fall prevention efforts are thus subject to resource allocation decisions made by elected officials through the political process.

RESOURCE ALLOCATION CONCERNS

In the mid-1990s, a cost-effectiveness analysis of a targeted individual-level multifactorial intervention on about 150 individuals provided estimates that ranged from the intervention saving money and preventing falls to the intervention costing $2,150 per fall prevented (1993 U.S. dollars) depending on whether mean or median costs were used (Rizzo, Baker, et al., 1996). The study provided support for implementation of a multifactorial risk assessment and intervention strategy in older adults, but did not suggest a pathway by which implementation should occur.

If a country were to work through its existing medical system to provide access to the evidence-based fall prevention interventions for its senior population, a population-based cost-effectiveness analysis should be performed. In such an analysis, the size and risk level of the target population, the intervention reach and penetration rate, the cost and effectiveness of the intervention, and the avertable healthcare costs should all be taken into account for resource allocation consideration. For example, if Medicare were to provide a structured coverage of a comprehensive falls risk assessment and reimbursement for exercise classes, a well-designed benefit package would have, under most circumstances, a cost-effectiveness ratio of under $2,500 per recurrent fall prevented, from Medicare's perspective (2002 U.S. dollars) (analysis available from S. Wu on request).

To compare the cost-effectiveness of individual-level interventions with a community-level intervention, we performed some rudimentary calculations. The "Stay on Your Feet" community-level intervention ran from 1992-1995 and cost $600,000 in Australian dollars (Kempton, van Beurden, et al., 2000). In 2007 U.S. dollars this equals approximately $560,000.[1] In a population of 80,000 adults age 60 and older, a reduction of 0.55 falls per 100-person months over the 4-year program period would translate to 21,120 falls prevented, or $27 in program costs per fall prevented. Although the program likely spurred additional expenditures on the part of individuals and local governments that are not accounted for in program costs, some of these additional costs might be offset by reduction in health care costs for fall-related injuries.

In thinking through resource allocation considerations, cost-effectiveness considerations need to combine with other concerns, such as feasibility of implementation, reach of the intervention into the community, and sustainability of approach, including attention to organization and financing of the intervention. Concerns of reach also relate to issues of equity: do we prefer to provide a small benefit to a large number of individuals, diffusely, through a community-level intervention? Or do we prefer to use an existing structure (such as the medical care system) to provide a fall prevention benefit to a smaller number of readily identifiable individuals who are at high risk?

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[1] $600,000 in Australian dollars equaled $406,800 in U.S. Dollars at the Interbank rate in on January 1, 1994. This equals $558,592.40 in 2007 U.S. dollars using the inflation calculator at the Bureau of Labor Statistics website (www.bls.gov).

Remaining questions

In a 1994 article, Tinetti outlined many of the pertinent research questions facing the field of fall prevention (Tinetti, 1994). Many of those questions are still pertinent today, and we will focus on questions that have implications for fall prevention programs at the community and national level.

The first question pertains to which subset of the population should receive multifactorial fall prevention interventions, which are more time-consuming (and therefore likely to be more costly) than exercise programs. In principle, high-risk individuals are the ones who should receive multifactorial evaluation and intervention (see Figure 1). However, the effectiveness of fall prevention depends not only on baseline risk, but also on malleability of risk. Geriatricians who see very frail patients observe that some patients continue to fall frequently despite intervention, and the focus for these individuals, at some point, expands from fall prevention to include reducing the risk of injury from falling.

We take the position of following clinical practice guidelines, which have recommended that individuals with a history of falls in the past year, or those with a gait or balance problem, should be targeted for multifactorial evaluation (American Geriatrics Society 2001; National Institute for Clinical Excellence, 2004), and a recent systematic review of screening strategies supports this approach (Ganz, Bao, et al., 2007). However, it is not clear if all older adults should be screened for fall risk, or how frequently screening should occur.

The next question is which components of the multifactorial evaluation are sufficient to achieve the benefit shown in randomized trials. This question is important at a policy level because if the multifactorial evaluation and interventions could be simplified, the process would be more cost-effective to implement. Exercise is likely to be the key component of multifactorial intervention, and additional randomized trials indirectly support vision assessment (Harwood, Foss, et al., 2005) and medication review (Campbell, Robertson, et al., 1999). Other components that have not been traditionally incorporated into all multifactorial assessments include assessing for and treating Vitamin D levels and reviewing footwear. The role of Vitamin D in preventing falls is uncertain, as a meta-analysis and subsequent large randomized trials reached different conclusions (Bischoff-Ferrari, Dawson-Hughes et al. 2004; Grant, Avenell, et al., 2005; Porthouse, Cockayne, et al., 2005). Regarding footwear, one randomized trial of a device to improve traction of shoes in winter conditions showed reduced outdoor falls (McKiernan, 2005), but whether these results warrant footwear assessment as part of a standard multifactorial evaluation is not clear.

A third question relates to the relative importance of preventive efforts directed at falls and osteoporosis. One of the most severe consequences of a fall is an osteoporotic fracture. Exercise, a mainstay of fall prevention, fortunately works to improve bone mineral density (Bonaiuti, Shea, et al., 2002), but whether multifactorial fall assessment programs should incorporate osteoporosis screening and treatment remains unclear.

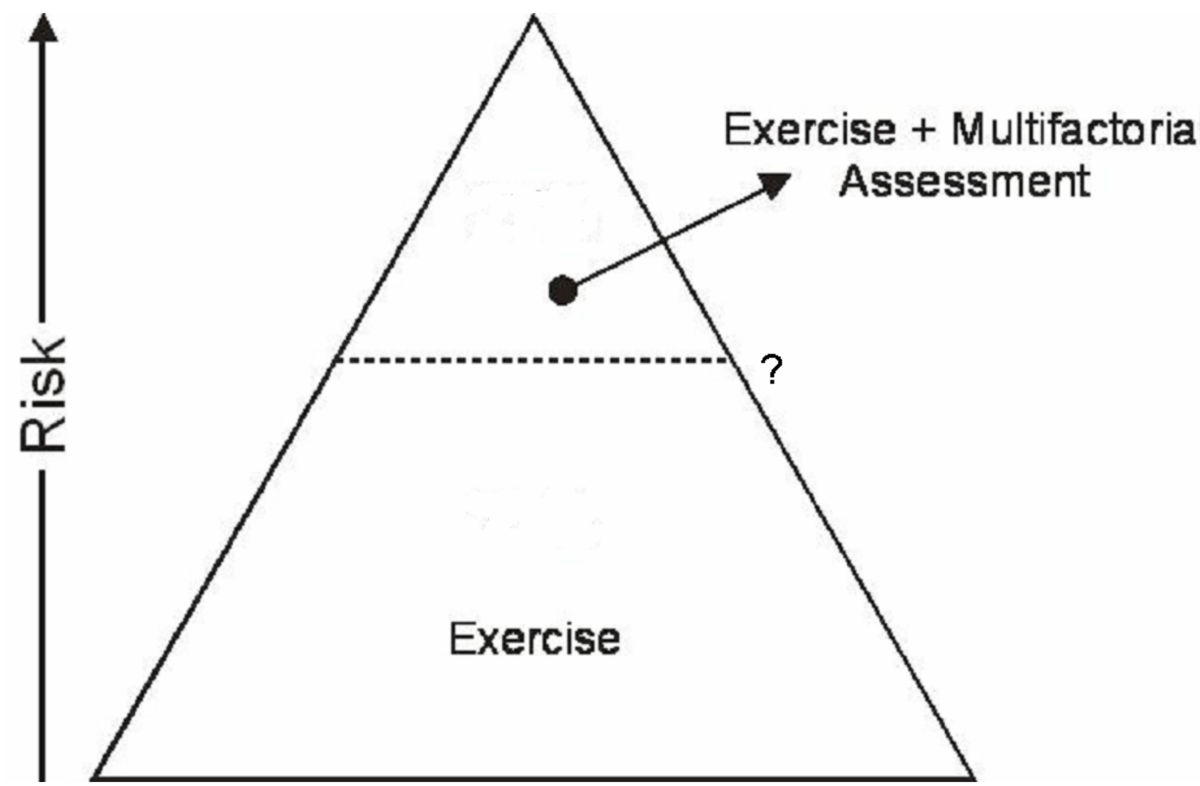
CONCLUSIONS

For conditions that particularly affect older adults, the evidence to support fall prevention efforts is among the best and unequivocal. When it comes to translating this evidence into community-level and national-level policy, however, the question becomes less about evidence and more about competing priorities and wisely using limited resources to improve health. Given that exercise, a key component of fall prevention, not only prevents falls but also has multiple beneficial effects on physical and mental health, we feel confident that exercise promotion for older adults should be the first priority of any fall prevention effort. Expanding utilization of existing exercise programs and lowering seniors' financial barriers to exercise is a logical first step towards exercise promotion, with the more long-term goal of fostering local environments for older adults that make exercise easy and enjoyable.

TABLE 1 Comparison of Absolute Reduction in Fall Rates Across Individual-Level and Community-Level Interventions, Expressed in Common Units.

Level of Intervention	Intervention	Number of Falls Reduced Per 100 Person-Months	Source
Individual	Multifactorial	11.8	(Chang, Morton, et al., 2004)
Individual	Exercise	2.7	(Chang, Morton, et al., 2004)
Community	Multifactorial	0.55	(Kempton, van Beurden, et al., 2000)

629 FIGURE 1 Fall Risk Pyramid.



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