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HHS Public Access

Author manuscript

J Hous Elderly. Author manuscript; available in PMC 2018 December 14.

Published in final edited form as:

J Hous Elderly. 2012 ; 26(1-3): 137–155. doi:10.1080/02763893.2012.673382.

Assessing and Adapting the Home Environment to Reduce Falls and Meet the Changing Capacity of Older Adults

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Abstract

Falls in older adults are a serious problem for individuals, their families, and the health care system. This article describes research regarding fall risk assessment, risk reduction interventions, and public policy aimed at reducing the risk of falls for older adults in home settings. Assessments for frail older adults should include observations of not only the physical environment, but also the interactions among the environment, behavior, and physical functioning so that interventions are tailored to the specific situation of the individual. Home modification and technology can prove useful when designing interventions aimed at reducing fall risks. Problems such as cost, reluctance to adopt or implement suggestions, and a lack of knowledge may present barriers to effective home modification. Program and policy options for the future include improved training for service personnel who visit the homes of older adults, increased awareness of and coordination between programs or interventions aimed at reducing the risk of falls in older adults, new sources of funding, and building more housing that follows the principles of universal design.

Keywords

environment assessment; fall prevention; home modifications

Falling and injuries associated with falls constitute a major risk to the health, well-being, and independence of older adults. Falls frequently serve as a precursor to or indicator of frailty that may result in increased need for help from others or even nursing home placement. Within the community, falls are a leading cause of injury, hospital admissions, and injury-related deaths. Beyond these human costs, falls among older adults also represent a major health care expense for public and private payers of medical claims. In 2000, the total direct medical costs of fall injuries and fatal falls exceeded $19 billion, or about $28 billion in 2010 dollars (Stevens, Corso, Finkelstein, & Miller, 2006). Due to the aging of the

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population, costs associated with falls are projected to continue increasing to approximately $55 billion (in 2007 dollars) by 2020 (Englander, Hodson, & Terregrossa, 1996). In addition, these direct expenditures fail to account for the long-term costs associated with later disability, formal and informal caregiving services, and other intangible resources. As a public health issue, older Americans' falls are a growing concern across policy domains, and there is common interest in reducing falls in the realms of public health, aging services, and housing.

Greater awareness among stakeholders in the domains of housing and construction/contracting regarding the consequences of falls and techniques for reducing fall risk has corresponded with important work done by occupational therapists and other professionals who provide home assessments and recommendations. The purpose of this article is to describe research on environmental fall risk factors and the strategies, programs, and policies aimed at addressing the problem of falls among a growing population of older adults.

ENVIRONMENT AS A FALL RISK FACTOR

Although Masud and Morris (2001) identified more than 400 individual fall risk factors, falls are commonly thought to result from interactions among multiple risk factors derived from behavioral, intrinsic, or extrinsic origins (Bath & Morgan, 1999; Bueno-Cavanillas, Padilla-Ruiz, Jiménez-Moleón, Peinado-Alonso, & Gálvez-Vargas, 2000; Cesari et al., 2002; Graafmans et al., 1996; Pynoos, Steinman, & Nguyen, 2010). A sometimes-overlooked category, Pynoos et al. (2010) described behavioral fall risk factors as those that reflect the choices of individuals with respect to how they interact within their environments. Examples of behavioral fall risk factors include performing behaviors that could decrease safety (e.g., standing on unstable objects to reach items that are stored on high shelves), failing to perform behaviors that could reduce fall risk (e.g., not turning on lights when using the bathroom at night or not using grab bars or handrails when they are present), or selecting unsafe clothing, footwear, or inappropriate/outdated eyewear prescriptions.

According to Pynoos et al. (2010), intrinsic factors are individually oriented risks that include health conditions (e.g., chronic diseases), degrees of functional impairment (e.g., poor mobility or cognitive decline), or states of being (e.g., advanced age). Other intrinsic fall risk factors include muscle weakness, gait and balance disorders, negative drug interactions, a history of falls, and sensory loss such as vision (American Geriatrics Society, 2012; Pynoos, Rose, Rubenstein, Choi, & Sabata, 2006). Intrinsic risk factors are often dynamic insofar as they may change over time, resulting in health and disability status that is in constant flux between losses and gains.

Finally, extrinsic fall risk factors are described as environmentally oriented and are shared among individuals who inhabit a common environment (Pynoos et al., 2010). Extrinsic factors that have been identified include slippery surfaces; inadequate lighting; loose, deep pile or worn carpets; staircases without railings; unsupportive or badly arranged furniture; poorly designed tubs, toilets, and fixtures in the bathroom; clutter; and pets being underfoot (Clemson, Cumming, & Roland, 1996; Pynoos et al., 2006; Rogers, Rogers, Takeshima, & Islam, 2004). Trips, slips, or stumbles are often attributed to extrinsic factors and may pose

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an increased risk for falls, especially for community-dwelling older adults whose homes may contain many hazards. In fact, the prevalence of environmental hazards in the homes of older adults was found to be high, with approximately 80% of homes containing at least one identifiable hazard and 39% containing five or more hazards (Carter, Campbell, Sanson-Fisher, & Gillespie, 2000). The degree to which the environment contributes to fall risk is often operationalized by the number of hazards contained in the environment. Nevertheless, research results have varied with respect to the magnitude of effect and circumstances in which hazards in the environment precede falls. For instance, Clemson et al. (1996) found that the homes of fallers were not generally more hazardous than the homes of non-fallers. However, fallers with cognitive impairments had significantly more hazards in their homes than non-fallers with cognitive impairments. Furthermore, homes of those with recent hip fractures had more hazards than those without hip injuries. Among older adults in general, Northridge, Nevitt, Kelsey, and Link (1995) reported that falls were not strongly associated with the presence of home hazards; however, among vigorous older individuals, those living with more home hazards were more likely to fall compared with those with fewer hazards. Thus, evidence exists that the effects of the environment may vary according to the physical capacity and the degree to which the individual is physically active. Indeed, Fleming and Pendergast (1993) found that although 50% of the falls they observed were precipitated by an environmental factor, a large percentage of these were likely caused by physical limitations that prevented residents from safely interacting with their environment.

A MULTIFACTORIAL MODEL OF FALL RISK

Because falls frequently result from multiple risk factors, including hazards in the environment, general consensus exists among researchers that the most effective prevention programs take an individualized and multifactorial approach to improving safety. Great variability is found in the needs, functional capacity, and environments of older adults, and risks may differ substantially between individuals. Therefore, the general approach has been to assess, identify, and address multiple factors that place the individual at higher risk for falls. The best assessment protocols (some examples are discussed below) are designed to be comprehensive in that they are able to identify health and environmental characteristics specific to individuals and their dwellings that place them at greater risk for falling (Rubenstein, Vivrette, Harker, Stevens, & Kramer, 2011). When behavioral risk factors are identified, they are often addressed through raising awareness and educating older adults about safer strategies for accomplishing everyday tasks and activities. To address intrinsic factors, multifactorial fall prevention programs may use medical risk assessments to identify health and functioning problems that can lead to falls. Whether prescribed or in group-based settings, exercise designed to increase strength, flexibility, and endurance can target and reduce the negative effect of intrinsic fall risk factors (Rose, 2011). In addition, home assessments and modifications designed to reduce or eliminate hazards in the environment would seem to be integral in programs aimed at reducing fall risk, especially because, as extrinsic in origin, they are amenable to control and correction.

The complex relationship between health and the physical environment with respect to fall risk has been acknowledged in theory and research aimed at understanding how multiple risk factors can combine to result in falls. In their efforts to describe interactions between older

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adults and their environments, researchers (Lawton, 1998; Lawton & Nahemow, 1973; Nahemow, 2000) proposed an ecological model in which the competencies of the individual, whether physical, interpersonal, or social/societal, are pressed by the demands of his or her surroundings. According to Glass and Balfour (2003), beneficial elements in the environment may serve as supports that buoy competence by reducing the discrepancy between the physical capacity of older adults (which may have declined due to age) and the relative press of their environments. Outcomes associated with this interaction determine the degree to which person–environment fit is adequate to support the needs and desired lifestyle of the individual (Iwarsson, 2005; Iwarsson, Horstmann, Carlsson, Oswalk, & Wahl, 2009). Elements in the ecological model are also dynamic in that the abilities of individuals and the challenges presented by environments are continually in flux, as is the interaction or relationship between them. Therefore, even when environments have been adapted to address the specific needs of individuals at a specific point in time, continued appraisal of the person–environment fit is necessary to assure that it remains appropriate over time.

The work of Lawton (1998) has served as a seminal theoretical basis for several studies that have attempted to demonstrate the benefits associated with multifactorial interventions. For instance, many studies have examined the role of the environment alone and with respect to other specific intrinsic and behavioral factors. Clemson, Mackenzie, Ballinger, Close, and Cumming (2008) reported on a meta-analysis of six multifactorial fall intervention studies that included an environmental component within community settings. Across studies, a significant 21% reduction in post-intervention falls was reported. In addition, Clemson et al. (2008) found differences in the efficacy of interventions based on the degree of risk experienced by participants, such that greater effects (39% reduction in falls) were reported for populations that had risks associated with previous falls, vision impairments, and functional decline. Similarly, Feldman and Chaudhury (2008) reviewed 25 empirical articles published from 1985 to 2007 that examined the role of environmental hazards, home modifications, and cognitive factors as they relate to falls in older adults and concluded that modifying the home environment was an effective intervention to prevent falls among this group. Based on such research, a conceptual model of multifactorial fall risk was developed that includes factors related to health and mobility, risk-taking behavior, and the physical environment (Feldman & Chaudhury, 2008). Collectively, these findings support the assertion that multifactorial fall risk is cumulative, such that fall risk increases as a function of factors individually or in combination with other factors (Rubenstein, Robbins, Josephson, Schulman, & Osterweil, 1990).

Another line of study has suggested that differences in the efficacy of multifactorial fall prevention programs may depend on the intensity of the interventions and the specialization of professionals conducting assessments. For example, Clemson et al. (2008) reported on four studies in which interventions with an environmental component were conducted by occupational therapists and found that these programs were more effective than similar interventions that did not include an occupational therapist. Pighills, Torgerson, Sheldon, Drummond, and Bland (2011) reported the results of a randomized controlled trial, which assessed fall outcomes for at-risk older adults following an environmental assessment and home modification intervention by either an occupational therapist or other trained assessor.

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Results of this study also found a significant reduction in post-intervention falls for the group that received the intervention from an occupational therapist, whereas the group that received the intervention from a trained assessor experienced no significant reduction in falls. In unpublished research reporting outcomes associated with the InSTEP (*Increasing Stability Through Evaluation and Practice*) program, which was funded by the Archstone Foundation, Kramer, Harker, Mitchell, and Rubenstein (2011) evaluated interventions at three intensity levels. The high intensity model included medical assessment by a physician, in-home assessment and follow-up assessment by an occupational therapist, and a focused balance and gait program taught by a trained, certified exercise professional. The medium intensity model used social workers for the medical risk and home assessment components, and a physical activity instructor to lead exercise classes. The low intensity model challenged older participants to be more proactive with their fall prevention efforts, with senior center staff or volunteers to follow-up and provide support. Although self-reported falls per year were reduced significantly for participants with previous falls, in this study program intensity level did not have a major effect on rates of falling. With respect to different types of assessors, Steinman and Nguyen (2011) analyzed the environmental assessment component of InSTEP, and the number of hazards found by various types of professionals who administered the Falls Home Assessment tool (described below). Occupational therapists identified more hazards than social workers, although this difference was not statistically significant. Statistical differences were reported regarding the location of hazards, with occupational therapists reporting more hazards than social workers in pathways and entrances leading to homes, on steps and stairs, and in a nonspecific “other” category that included the garage and the backyard. Thus, mixed evidence was found regarding to what extent the qualifications of the assessor, as well as the intensity of the assessment, influence the effectiveness of environmental fall-prevention interventions.

ASSESSMENTS FOR FALL RISK

For environmental modification to be effective, assessment tools are needed for identifying problems and offering solutions to hazardous areas in homes. Several home assessment tools have been developed that differ with respect to their complexity and the amount of time, training, and resources needed to administer them. The simplest and least expensive environmental assessment tools are self-administered checklists that help identify common hazards or solutions to hazards that exist in the homes of many older adults. In addition to their relative low cost and ease of administration, checklists usually require little or no training to conduct and may be disseminated directly to older adults via facilities where older adults may congregate to receive services (such as senior centers and health clinics) or through Internet sites that target older adults in need of services. Checklists can also be used or distributed by professionals such as builders and remodelers to engage clients and residents in the process of creating safe homes and in defining and prioritizing unsafe areas for improvement of the home environment.

An example of a home assessment checklist is “Check for Safety: A Home Fall Prevention Checklist for Older Adults,” disseminated by the Centers for Disease Control (CDC) (2005) and attainable in large print from the CDC’s website (http://www.cdc.gov). Another resource produced by the CDC is a self-administered fall-risk checklist, Stay Independent, adapted

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from a checklist developed by the Greater Los Angeles VA Geriatric Research Educational Clinical Center (Rubenstein et al., 2011). In addition to tips for making homes safer, items in this tool connect intrinsic fall risks to interactions with the environment (e.g., "I steady myself by holding onto furniture when walking at home" and "I need to push with my hands to stand up from a chair") and encourage individuals to discuss their fall risk factors with health care providers. Similarly, the Rebuilding Together Home Safety Checklist, created in partnership with the U.S. Administration on Aging (http://www.rebuildingtogether.org) covers not only the identification of fall hazards, but also accessibility and safety considerations.

Despite their convenience, it should be noted that checklists vary greatly with respect to their comprehensiveness and suggested solutions may be generic or may not apply in all cases (especially in the case of older adults who have impairments that require specific types of modification) (Pynoos et al., 2010). For example, checklists that are designed for older adults in general may overlook some problems that are especially important for individuals who are blind or visually impaired (Steinman, Nguyen, Pynoos, & Leland, 2011). The adoption of recommendations presented by checklist assessments may also vary according to the willingness of older adults to change aspects of their homes and their confidence about the extent to which making changes will influence their likelihood of falling (Cumming et al., 1999). Therefore, checklists may be more effective if they are accompanied by other educational materials that inform older adults in appropriate terms about research-validated findings emphasizing the correct use of home modifications and the efficacy of making specific changes to reduce fall risk.

In contrast to checklists, some assessment instruments, designed for use by health care or social service professionals, identify fall risk factors in the environment and explore the interactions of the individual with their surroundings (functional assessments). Environmental fall risk assessments use a more comprehensive approach that requires greater expenditure of time and resources to administer. In addition to items present on the assessment tool, assessors may call on their past experiences to provide an array of possible solutions to address hazards. Some examples of assessment instruments include the Falls Home Assessment, which has been developed and tested as part of the InSTEP program at the Fall Prevention Center of Excellence (http://www.stopfalls.org), and the more broadly based Comprehensive Assessment and Solution Process for Aging Residents (http://www.ehls.com) (Sanford, 2010; Sanford, Pynoos, Tejral, & Browne, 2002). These assessments incorporate a decision-making process that directly involves older adults in identifying their greatest needs or problems. Input from older adults may be helpful in selecting solutions among a variety of alternatives and setting priorities about what aspects of the home environment to change. It may also be important to include caregivers and family members in the process of identifying problems and setting priorities (especially in the case of individuals with Alzheimer's disease) to determine the best solutions given the individual's current state of health, projected changes to health, affordability of alternatives, as well as the attractiveness, safety, and ease of use of the solutions (Gitlin, Corcoran, Winter, Boyce, & Hauck, 2001).

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Several other fall home assessment tools exist that differ with respect to their structures and key areas of focus. The Housing Enabler http://www.enabler.nu/) uses a multi-step procedure to make predictive, objective, and norm-based assessments and analyses of accessibility problems in the physical environment. “Safety Assessment of Function and the Environment for Rehabilitation–Health Outcome Measurement and Evaluation” is an occupational therapy assessment developed for use with the elderly and adults with disabilities living in the community. It consists of an easy-to-use checklist grouped into 12 areas of concern: living situation; mobility; environmental hazards; kitchen; household; eating; bathroom and toilet; medication, addiction and abuse; leisure; communication and scheduling; personal care and wandering. The 100-page manual provides administrative instructions, detailed guidelines and seven case studies (Chiu, Oliver, Tamaki, Faibish, & Sisson, 2001). Finally, In-Home Occupational Performance Evaluation is a performance-based measure that evaluates 44 activities in the home with four subscales including activity participation; client’s rating of performance; client’s satisfaction with performance; and severity of environmental barriers (Stark, Somerville, & Morris, 2010). Although this is by no means an all-inclusive list of fall prevention checklists and assessments, they provide some insight into the types of tools that are currently available.

UNIVERSAL DESIGN, HOME MODIFICATIONS AND TECHNOLOGY

Over the past 20 years, greater emphasis has focused on designing and building dwellings that are sensitive to the needs of individuals with disabilities or those who may acquire disabilities at some point in the future. Public policies including the Americans with Disabilities Act of 1991 and the Fair Housing Amendments Act of 1988 have required that public and private environments be accessible and promote inclusion of people with disabilities. Similarly, activism by disability and aging groups has raised awareness about issues of accessibility and visitability (discussed later) of new and existing structures (Alley, Liebig, Pynoos, Banerjee, & Choi, 2007). A greater promotion of design that is accessible and supportive along with home modifications and assistive technology aims to accommodate individuals with physical and mental impairment in both new dwellings and housing that is older or poorly designed.

The concept of universal design has been used to create products, buildings, and exterior spaces that reduce environmental demands for people of all ages, sizes, and abilities to the greatest extent possible without the need for adaptation. Effective universal design minimizes barriers and increases supportive features to facilitate participation in activities of daily living and leisure activities (Mace, Hardie, & Place, 1996). Among many other possibilities, universal design features that can reduce the number of falls at home include a zero-step entrance with flush or low-profile threshold; high-contrast trim and glare-free floor surfaces; a curbless or roll-in shower in bathrooms; short, wide hallways that can accommodate a person using a wheelchair or walker, as well as caregivers providing assistance; and motion-sensor lighting that automatically turns on and off when individuals enter or exit the room (Pynoos, 1992; Pynoos et al., 2010; Young, 2006).

In homes that are older or poorly designed, the process of home modification refers to the converting or adapting of environments to make everyday tasks easier, reduce accidents, and

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support independent living (Pynoos, Sabata, & Choi, 2005). The dynamic nature of health and functioning among older adults, especially those with chronic diseases, mandates the continued monitoring of home safety even after homes have been assessed and features such as grab bars and handrails are in place. Even though in some circumstances, a single event might precipitate the need for home modifications, the process is better viewed as one that occurs over time. Follow-up visits or telephone calls by health professionals can help determine whether more training should be offered or if additional modifications are needed to respond to the changing needs of the older person.

According to Steinman and Nguyen (2011), home modification recommendations made by a home assessor (e.g., an occupational therapist or social worker) to individuals about their environments can be grouped into at least four categories: additive, subtractive, transformative, and behavioral modifications. The most common recommendations are for additive modifications in which supports or structures are added to the environment to facilitate access and functioning of the user. Additive modifications may include major additions (e.g., installing ramps for wheelchair users) or relatively minor additions (e.g., adding an automatic nightlight in the hallway). Because additive modifications commonly require professional installation of new features by hired contractors or other professionals, they may be relatively expensive compared with other types of modifications.

By contrast, subtractive modifications involve the removal of items or hazards to improve safety and access to the environment. Subtractive modifications include changes such as removing unsecured floor mats or clearing clutter from the floor. Subtractive modifications tend to be less expensive and may be easier for individuals to implement on their own without professional assistance because they do not involve installing new features.

Transformative modifications involve restructuring existing characteristics to better facilitate the use of environmental features. Widening doorways to improve accessibility for individuals who use wheelchairs is an example of a major transformative modification. Transformative modifications may also include relatively minor changes, such as rearranging furniture to clear pathways or relocating frequently used objects such as cooking utensils, so that they are within easy reach.

Finally, behavioral modifications include avoidance or adoption of specific behaviors to improve safety. Behavioral modifications involve altering how individuals interact with their environments. For example, when stairs are identified as a hazard, individuals may modify their behavior by sleeping on the first floor instead of the second. In accordance with Lawton and Nahemow’s (1973) ecological model of person–environment fit, behavioral modifications are unique because they acknowledge the potential of behavior change as a means to reestablish equilibrium between the capabilities of individuals, and the environments in which they function. Thus, when suggesting behavioral interventions, providers should explore how personal attributes of the individual and their environment interact as they perform daily activities.

Advances in mainstream technology (marketed to the public at large) and assistive technology (designed to promote independence for individuals with disabilities) also

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promote the ability of older adults to continue to live in their own communities as they age (Vasunilashorn, Steinman, Liebig, & Pynoos, 2012). Smith and Small (1983) described the major benefits of applying technological advances for increasing the safety of older individuals living in their own homes, especially those living alone. Since that early period, innumerable advances in technology have been made that promise to improve the capacity of individuals to remain at home. As is true with universal design and home modifications, technology may be useful in fall prevention interventions as potential buoys to problems that are either created or exacerbated by interactions between physical capacity and the environment. For example, several low-tech assistive devices (e.g., that assist with reaching and gripping) and mobility devices (e.g., canes, walkers) are on the market that can substantially reduce fall risk. In addition, a growing number of high-tech devices are being developed that gather biological and kinesthetic data to detect when falls have occurred or are imminent (Yu, 2008). In very frail older adults, sensors embedded in garments can be used to detect suspicious movements that often precede falls and may be able to alert caregivers to a potentially hazardous movement or balance-related situation. Cameras and ambiance devices that detect movement or vibrations have been equipped with sophisticated software programs that connect to personal emergency response systems. The improved ability of technology to interpret high-risk movement patterns has facilitated the process of alerting caregivers when risky behaviors are undertaken. Older adults who are less frail have also benefited from the explosive growth in technological devices that range from motion-activated lighting to phone applications (apps) that help monitor and send reminders to take medications. In the spirit of universal design, many technological devices used by people of all ages are now designed to also accommodate the changing physical needs and capacities of individuals as they age. Whereas research has shown that older adults are often willing to adopt technologies that would help them remain independent (Brownsell, Bradley, Bragg, Catlin, & Carlier, 2000), it is important that technology is designed to facilitate access and avoid barriers to use. Simple-to-use, unobtrusive technology, as it continues to develop, will be integral in promoting safety by accommodating disability associated with cognitive, sensory, and mobility impairment.

BARRIERS TO SAFE HOME ENVIRONMENTS

Despite great improvements, much of the current built environment, including the homes of older adults, still contain hazards that increase the risk of falls and lacks features to prevent or reduce falls. The mismatch between the needs of older adults and their environments exists for sundry reasons that relate to scarcity of resources and limited support and information available to older adults about alternatives that address environmental risks. Older adults may be unaware that environments contain hazards or may be unable to make the changes themselves or get a friend, neighbor, or relative to do it. In addition, a lack of trained assessors exists, and it is often difficult to locate a skilled installer. Older adults may even reject home modifications due to their often non-residential appearance or the costs associated with making changes. Indeed, costs are often a major barrier to implementing home modifications. Those who have low incomes and live in substandard housing with problems such as broken stairs or crumbling bathroom walls may need structural repairs before adding such home modifications as handrails, stair glides, or grab bars. Likewise,

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many low- and high-tech assistive devices may be beyond the financial means of individuals with low incomes. Moreover, because many home modification programs are often lodged in housing agencies, there can be difficulties in coordinating with health and human services because they target different population groups, vary in the qualifications for eligibility, and operate under different time frames.

PROGRAMS AND POLICIES

Several policies and programs have been developed to address barriers that have stood in the way of reducing environmental fall risks. Among the multi-faceted programs included in the CDC's Compendium of Effective Fall Interventions (Stevens, 2010), many include a component that focuses on home assessment and modification. In addition, recent efforts have been made to upgrade the skills of individuals who conduct home assessments and modification and to address the problem of inaccurate or cursory assessments. Educational and skill-building programs include a series of multisession online certificate programs in home modifications that are available from the University of Southern California's Davis School of Gerontology; the American Occupational Therapy Association; I.D.E.A.S., Inc. has a set of online education modules that pertain to home modifications and the environment, including one on falls; the University of Buffalo has several online courses on universal design and home modification; and The National Association of Home Builders offers remodelers a 2-day program on aging in place and accessibility.

In addition to the growing focus on training programs, efforts have also been made to increase the absolute number of assessors who are available by enlisting new groups to participate in the assessment and referral process. Other professionals who could do a quick assessment of the home include firefighters and emergency medical services (EMS) responders. In addition to responding to fires, firefighters and EMS personnel frequently address medical emergencies, such as cardiac arrests and falls. As trusted personnel, firefighters and EMS responders have the opportunity to capitalize on these teachable moments by administering a quick in-home environmental screen to identify common fall risks within the environment and referring individuals to programs and services in the community. FP Connect, a project at University of Southern California's Andrus Gerontology Center, is working with local firefighters and EMS personnel to determine the best way to provide fall prevention and reduction training so they can use the short period of time they are in the individual's home to effectively conduct a home assessment, leave recommendations for changes, and refer them to individuals or organizations that can make changes.

At the federal level, the National Affordable Care Act's "Independence at Home Demonstration" (Centers for Medicare and Medicaid Services, 2012) is testing the efficacy of house call visits for frail older individuals by doctors. Once common in the United States and still a practice in countries such as England, physician house calls provide a potentially effective avenue for identifying fall risks. Although the demonstration does not provide designated funds for home modifications, it offers the opportunity for physicians to observe how older individuals function in their own settings overtime and, if needed, make appropriate referrals to other services, such as occupational therapy and handy workers.

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Similarly, other health care or social service professionals (e.g., nurses, case managers, and in-home workers) who have access to older adults in their homes can be trained in assessing environments for fall risks. It is expected that these types of visits will increase as health care moves more into home settings (National Research Council, 2011).

With respect to funding for home modifications, several housing programs exist in the United States, such as Community Development Block Grants and Veterans Administration grants (targeted to wounded and disabled veterans), that can pay for home repairs and modification. Health-related programs such as Medicaid Waivers may also allow funds to be used in modifying homes. Still, expenditures for home modification programs are optional, and they are often at a high risk for elimination or retrenchment when government budgets are cut. Newer programs, such as PACE (Program of All Inclusive Care for the Elderly) and Cash and Counseling, which have greater flexibility in how funds are used, may institute home modifications as a strategy to keep frail older adults in the community. They have the advantage of caring for frail older individuals over an extended time, the opportunity to conduct home assessments as part of care plans, and the ability to integrate fall prevention (including home modifications) as part of on-going services that they provide. Even though they are increasing in number, due to their limited resources such programs are able to serve only a relatively small percentage of older individuals who could benefit from their services and are restricted to those with a very low income. Depending on their particular policy, middle- and upper-income individuals who have purchased private long-term care insurance and who meet the threshold for services may be able to use funds for home modifications. Likewise, older homeowners who take out a reverse mortgage can use funds from it to make repairs and modifications.

FUTURE DIRECTIONS

Many policy and research challenges lie ahead in the realm of falls prevention via hazard reduction and environmental assessment. To adequately address the role of the home environment in falls—a problem that is only likely to grow over time—new strategies and interventions must be developed, and new resources must be committed to ameliorating fall hazards in homes of older adults. In addition to material resources, greater advocacy is needed to assure that policymakers are well-informed about what works, what resources are needed to improve environments, and what is at stake in terms of human and economic costs. Moving forward, the combined efforts of professionals in the domains of public health, aging services, and housing will likely continue to focus on the development of environmental solutions that accommodate and support the greater physical and cognitive demands that often accompany aging. For example, improved integration of universal design principles into housing designs will benefit older adults by improving home access and safety for all people. Activists and advocates in the disability movement have also served to raise awareness of the role of environment in activity participation and safety of older adults. The concept of visitability, originally conceived by Eleanor Smith of Concrete Change, has promoted housing codes in the United States that would require a small set of essential features on the first floors of visitable houses to allow for access by individuals with mobility concerns, including a level entrance, an accessible bathroom on the first floor, and wide doorways and hallways that allow for the passage of a wheelchair. Although visitability

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has not yet had the large effect that its advocates hope to eventually achieve, as of 2008 approximately 30,000 homes were built according to its requirements (Pynoos, Nishita, Cicerso, & Caraviello, 2008; Rehabilitation Engineering Research Center on Universal Design, 2008).

In addition to improved advocacy, programs that serve older adults should have access to research results by way of wider dissemination of information translated into clear, easy-to-understand formats available to professionals outside of academic and scholarly journals. Stronger ties and relationships between researchers and service providers will help to ensure that interventions related to the environment are efficacious and based on a wide body of scientific evidence.

With respect to research, new data sources aimed at understanding the causes of falls and methods of intervention need to be developed. Many of the data regarding environmental fall risk factors are cross-sectional, and better national longitudinal data could include well-formulated questions about falls experienced by older adults, and home modifications implemented to address falls (Beasley, Jason, & Miller, 2011). New sources of data could be derived from different types of providers that have contact with older adults who have fallen. For example, when older adults who experience serious falls are transported by EMS personnel to hospital emergency departments, this negative scenario has potential to result in more positive outcomes if EMS personnel used the opportunity to collect more detailed and uniform information about contributing factors leading up to falls, including medical precursors and the role of the environment. Similarly, states could improve access of researchers to emergency room discharge data that pertain to falls (Wallace, Molina, & Jhawar, 2007). Health Maintenance Organizations and programs such as PACE that operate using a comparatively holistic approach to providing health care for older adults would seem to have a strong interest in collecting improved falls-related data and testing interventions to reduce falls. Since passage of the Deficit Reduction Act of 2005, hospitals and nursing homes in particular now have a greater incentive to understand and prevent falls through collection of better data. As a result of Deficit Reduction Act, the Centers for Medicare and Medicaid Services no longer reimburse hospitals for the treatment of fall-related injuries that occur within their facilities.

Finally, more research is needed that clearly explains the role of the environment in the complex mosaic of fall risk. Much of the falls research to date has focused on identifying risk factors for falls, demographic analysis of adults who fall, and interventions designed to prevent falls. This work has demonstrated, and it is now generally agreed, that falls are a result of complex interactions between factors that are intrinsic and extrinsic to the individual. As a result, many programs have begun to include assessment and modification of the environment as a central component of multifactorial fall-reduction interventions. Even so, additional research is needed to ascertain the effectiveness of different types of assessors (e.g., occupational therapists, social workers, family members, and older adults themselves) and various methods of assessment (e.g., self-administered checklists, functional assessments). In addition, expanded research will lead to better understanding the extent to which costs, ease of making modifications, appearance of modifications, tenure of

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residents (renter vs. owner), living arrangements, and the perceived usefulness of home modifications influence the decisions of older adults to implement changes in their homes.

Successful efforts to improve the environments of older adults and to reduce their risk for falls and fall-related injuries are complex and transdisciplinary undertakings. As such, future efforts to improve home safety will require that policymakers, practitioners, and other stakeholders in the medical, public health, housing, transportation, and social service sectors each acknowledge the role of physical and behavioral characteristics of older adults in context with their environment in falls risk, while embracing policies and practices designed to improve the home environments of older adults. Although many challenges and barriers remain, environmental gerontology continues to develop new opportunities and advancements to address these pressing problems. Indeed, future efforts to reduce fall risk that is attributable to a mismatch between functional health and the environment should focus on assessments, technology, and public policy aimed at reducing the environmental press in homes where older adults live.

Acknowledgments

Support by a grant provided by the Archstone Foundation.

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