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Special Report from the CDC

CDC's research portfolio in older adult fall prevention: A review of progress, 1985-2005, and future research directions

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Abstract

Problem: Falls are a leading cause of mortality and morbidity among adults age 65 and older. Population models predict steep increases in the 65 and older population bands in the next 10–15 years and in turn, public health is bracing for increased fall rates and the strain they place on health care systems and society. To assess progress in fall prevention, the Centers for Disease Control and Prevention conducted a research portfolio review to examine the quality, relevance, outcomes and successes of the CDC fall prevention program and its impact on public health. *Methods:* A peer review panel was charged with reviewing 20 years of funded research and conducting a SWOT (strengths, weaknesses, opportunities, and threats) analysis for extramural and intramural research activities. Information was collected from grantees (via a survey instrument), staff were interviewed, and progress reports and products were reviewed and analyzed. *Results:* CDC has invested over $24,900,000 in fall-related research and programs over 20 years. The portfolio has had positive impacts on research, policies and programs, increasing the public health injury prevention workforce, and delivering effective fall prevention programs. *Discussion:* Public health agencies, practitioners, and policy makers recognize that while there are some evidence-based older adult fall prevention interventions available, many remain unused or are infeasible to implement. Specific recommendations across the public health model, include: additional research in gathering robust epidemiologic data on trends and patterns of fall-related injuries at all levels; researching risk factors by setting or sub-population; developing and testing innovative interventions; and engaging in translation and dissemination research on best practices to increase uptake and adoption of fall prevention strategies. CDC has responded to a number of suggestions from the portfolio review including: funding translation research of a proven Tai Chi fall intervention; beginning to address gaps in gender, ethnic, and racial differences in falls; and collaborating with partner organizations who share in CDC's mission to improve public health by preventing falls and reducing fall-related injuries. *Impact on Industry:* Industry has an opportunity to develop more accessible and usable devices to reduce injury from falls (for example, hip protectors and force reducing flooring). By implementing effective, evidence-based interventions to prevent falls and reduce injuries from falls, significant decreases in health care costs can be expected.

Keywords: Injury; Older adults; Elderly; Falls; Older adult falls; Fall intervention; Translation and dissemination; Falls research; Public health; Research portfolio review; CDC Injury Center

1. Introduction

For more than 20 years, the National Center for Injury Prevention and Control (NCIPC) and its predecessors at the Centers for Disease Control and Prevention (CDC) have been conducting research to help prevent falls and their injurious consequences among older adults. This paper summarizes a peer review and report of the National Center for Injury Prevention and Control's (Injury Center) research portfolio of projects related to fall prevention, which was conducted in 2006 by an external objective peer review panel for the purpose of assessing the quality, relevance, outcomes, and successes of the program, and its impact on public health.

2. Background

Falls are a leading cause of mortality and morbidity among adults age 65 and older (CDC, 2006). Each year, an estimated one third of older adults fall, and the likelihood of falling increases substantially with advancing age (Stevens, Mack, Paulozzi, & Ballesteros, 2008; Hornbrook et al., 1994); 20% to 30% suffer moderate to severe injuries, such as traumatic brain injuries and fractures, which reduce mobility and independence,

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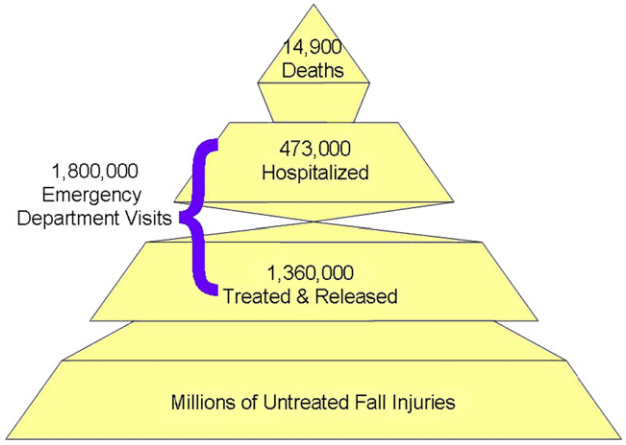

Fig. 1. Burden of Older Adult Falls.

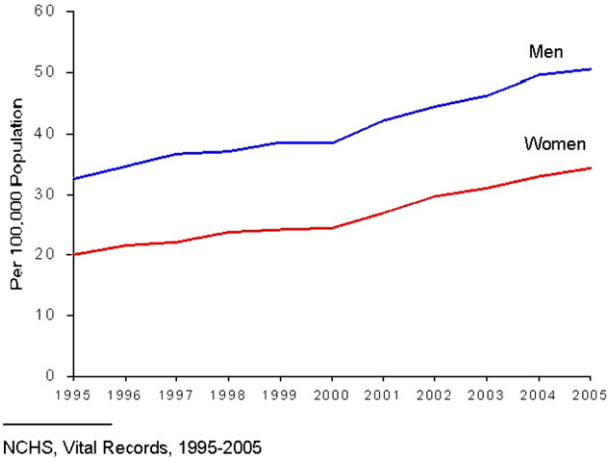

Fig. 3. Trends in Age Adjusted Fall Death Rates-1995-2005.

and increase the risk of premature death (Sterling, O'Connor, & Bonadies, 2001).

Falls are the leading cause of injury deaths for adults over age 65 and are the most common cause of nonfatal injuries and hospital admissions for traumatic injuries. In 2005, in the United States, almost 15,000 older adults died from falls, approximately 1.8 million were treated in hospital emergency departments for unintentional fall-related injuries, and 473,000 of those were subsequently hospitalized (CDC, 2006; Fig. 1).

Of the 2.9 million non-fatal injuries to older adults, 63% was attributed to falls (Fig. 2). Fatal and nonfatal fall rates increase sharply with advancing age, with the greatest increase occurring after age 80. During the past decade, age adjusted death rates for both men and women have increased dramatically and death rates remain higher among men than women (Fig. 3). Among people aged 65 and older, the fatality rate for men is almost 60% higher than the rate for women, while nonfatal fall injury rates are higher among women (CDC, 2006). The underlying causes for this disparity are unclear.

Falls and fall-related injuries represent an enormous burden to individuals, society, and to our health care system. About 32% of older adults who sustain a fall-related injury required help with activities of daily living, and among them, 58.5% were expected to require help for at least six months (Schiller, Kramarow, & Dey, 2007).

Among adults aged 65 and older, direct medical costs totaled $179 million for fatal fall-related injuries and $19.3 billion for

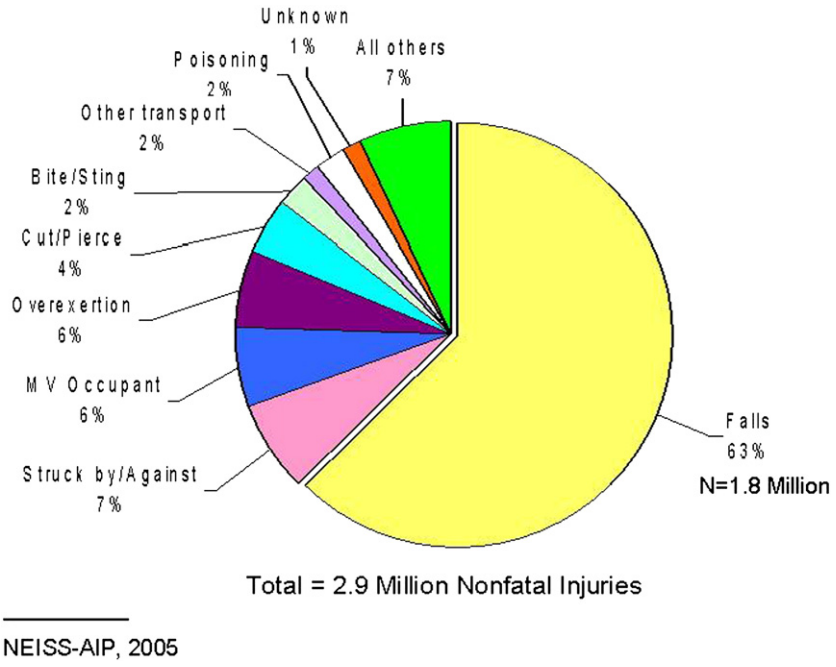

Fig. 2. Causes of Older Adult Non-Fatal Injury.

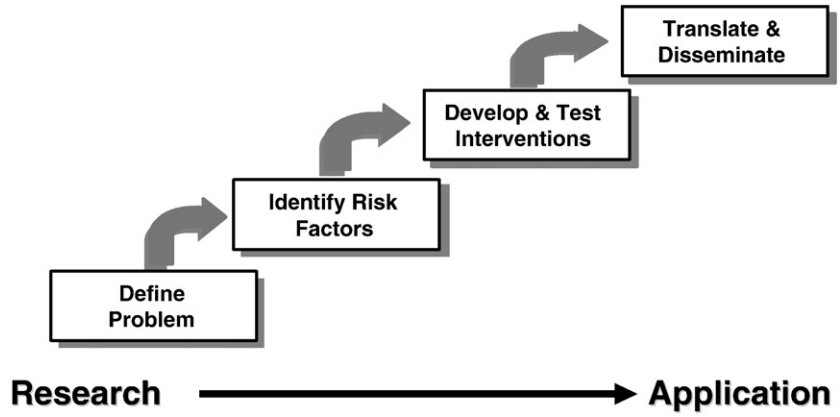

Fig. 4. The Public Health Model for Disease and Injury Prevention.

nonfatal fall-related injuries, of which $12.1 billion was for injuries that required hospitalization, and $4.1 billion was for injuries treated in emergency departments (Stevens, Corso, Finkelstein, & Miller, 2006). By 2020, the total annual cost of these injuries is projected to reach $43.8 billion in current dollars (Englander, Hodson, & Terregrossa, 1996).

The most serious fall-related fractures are hip fractures. Each year, about 300,000 adults aged 65 and older fall and fracture their hip. Of those older adults living independently before their hip fracture, only half are able to live independently a year later (Magaziner, Hawkes, Hebel, Zimmerman, Fox, Dolan et al., 2000). In 1991, Medicare costs for hip fractures were estimated to be $2.9 billion US dollars (CDC, 1996).

3. Public Health and CDC's Role in Fall Prevention

For people aged 65 and older, falls are the leading cause of injury mortality and morbidity leading to early death, severe injuries such as traumatic brain injuries and fractures, and conditions that reduce mobility, independence and the quality of life.

Although many federal, state, and local governments, private organizations, and foundations support fall prevention research, only CDC takes a comprehensive public health approach to the issue. NCIPC is the only organization in the federal government with the responsibility to address all stages of injury research. Using the public health model as a framework (Fig. 4), NCIPC addresses fall prevention at each stage: from surveillance activities that define the extent of the problem, through identifying fall risk factors, to developing and testing interventions, and finally, to translating and disseminating effective interventions nationwide.

The priorities for injury prevention and control at CDC and NCIPC have evolved steadily over the past two decades. The *CDC Injury Research Agenda*, (NCIPC, 2002), which guides NCIPC research funding, contains three major older adult fall prevention research priorities: (a) develop and evaluate community-based interventions, (b) evaluate dissemination strategies, and (c) identify opportunities to overcome barriers to interventions. NCIPC's fall prevention activities also are aligned with the Healthy People 2010 objectives to reduce the national fall death rate and to reduce the rate of hip fracture among older adults (Sleet, 2007).

4. The Research Portfolio Review Process

The *CDC Older Adult Fall Prevention Research Portfolio Review* (Sleet, Moffett, & Stevens, 2007) was conducted in 2006 in response to a CDC-wide policy requiring the periodic peer review of both intramural and extramural research. It describes the 20-year history and current status of the CDC older adult fall prevention research program. The review sought to answer questions about the relevance of the projects to CDC's goals, the impacts and outcomes of the projects, the quality of both the projects and their outcomes, and future directions for fall prevention research.

Methods used to conduct the review included information collected from grantees, grant reports, interviews with project officers and grants staff, interviews and record reviews from staff scientists, and analysis of available NCIPC records, reports, and documents related to each funded project during the past 20 years. An independent contractor was responsible for collecting the data, analyzing it, synthesizing it, and preparing a report based on its findings. The Peer Review Panel was charged with overseeing the process, reviewing the report, conducting a SWOT (strengths, weaknesses, opportunities, and threats) analysis, providing its perspective on NCIPC's progress and accomplishments, and making recommendations to CDC relevant to the gaps in research and opportunities to address future challenges. Both intramural and extramural research activities were assessed.

The assessment focused on four questions: (a) To what extent has the body of funded projects been relevant to, and distributed across, each stage of the public health model and the priorities of NCIPC? (b) What were the reported outcomes and impacts of the projects? (c) Were the projects conducted in a manner expected by NCIPC and the injury research community, and did they yield quality outcomes? (d) What opportunities exist for expanding the research portfolio to fill knowledge gaps, to further the NCIPC research agenda, and ultimately, to reduce the number of fall-related injuries in the United States?

Exhibit: Example of one research portfolio project description

Understanding Factors that Influence Hip Protector Use Among Community-Dwelling Seniors

Researchers at the University of North Carolina's Injury Control Research Center conducted research to understand the factors influencing older adults' use of hip protectors. Studies have shown hip protectors are an effective way to reduce the risk of fractures from falls, yet hip protector use among older adults is relatively low. While hip protector manufacturers have done some marketing research to assess use and non-use, not much is known about why the use of hip protectors remains so low.

Following a preliminary CDC-funded hip protector symposium in Boston, researchers gathered in-depth information from community-dwelling older adults about their experience using hip protectors and their proclivity for regular use. Subjects tried on various models of hip protectors, then researchers convened a focus group and individual interviews to assess their experience and explore barriers and motivators for use. The focus groups and individual interviews yielded some unexpected preliminary results. Study participants cited their concerns about hip protector comfort and convenience and about the ways hip protectors changed their appearances. They also revealed a concern that wearing hip protectors was a sign of old age and reported that they did not see themselves needing them or benefiting from them. While these results are preliminary, this study has uncovered several unrecognized patient barriers to hip protector use that need to be addressed before widespread adoption of this effective intervention can be expected.

5. Results

5.1. Intramural Program

The intramural research program and fall research portfolio is small relative to the extramural portfolio. The intramural research program has three components: (a) surveillance activities and dissemination of surveillance data, (b) portfolio and program support activities, and (c) research and analytic activities, including conceptualizing new research. It was difficult to quantify the contributions of the intramural research portfolio when compared with the overall research program because of the small number of intramural researchers (one senior research epidemiologist and some part-time staff) and limited institutional funding, primarily for analysis. Much of the intramural research at NCIPC is conducted as part of the intramural researchers' official duties and is not supplemented or supported by institutional funds. However, intramural researchers at NCIPC were judged to have been prolific in their publications and presentations, and in the impact of their research in the field (judged by impact factors of publications). *[The impact factor is a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period. The annual Journal Citation Reports impact factor is a ratio between citations and recent citable items published.]* The outputs of intramural research included 55 peer reviewed publications in the 20-year span with a mean impact factor of the journals of 3.69 (0.17–17.59). The dissemination and collaboration work of intramural researchers with researchers in other federal agencies outside CDC was judged to have clearly contributed to placing fall prevention on the national public health agenda and in moving the field forward.

Specific accomplishments within the intramural program, according to each stage in the public health model include:

- *Defining the problem*: Established the National Electronic Injury Surveillance System All Injury Program that provides the only national estimates of fall-related injuries treated in emergency departments;
- *Identifying risk factors*: Conducted an epidemiological Study to Assess Falls Among the Elderly (SAFE), an early case-control study in Florida that documented the impact of the home environment on fall injuries by measuring both the presence of home hazards and frequency with which seniors were exposed to the hazards;
- *Developing and testing interventions:* Funded five randomized controlled trials to evaluate the effectiveness of fall prevention interventions among different senior populations;
- *Disseminating effective interventions*: Established the National Resource Center for Safe Aging, an interactive web-based resource center that provides public health professionals, health care providers, and senior service agencies with information about injuries among older adults.

Other research projects included identifying risk and protective factors for falls; TBI, brain injury and falls; calcium intake, exercise, and falls; the importance of social support; fall prevention checklist and tool kit; costs of falls, home assessment and modification; epidemiology of falls; fear of falling; effects of exercise; walking aids; seasonal patterns of falls; the potential of Tai Chi; and functional limitations and falls.

5.2. Extramural Program

Extramural research received the majority of research funding over the 20-year period. Extramural fall-related funding totaled approximately $24,900,000 (in 2005 dollars). These funds were distributed using four types of funding mechanisms: (a) Injury Control Research Centers (ICRC; 11 projects), (b) Cooperative Agreements (13 projects), (c) R01 (investigator initiated) Grants (10 projects), and (d) Small Business Innovation Research Grants (SBIR; 1 project). Projects funded through the Cooperative Agreement and R01 mechanisms received the equivalent of at least $750,000 per project for the project period. From 1986 to 2005, NCIPC funded 35 projects in 18 states. Four projects were designed only to build capacity or infrastructure, 20 were only to conduct research and/or evaluation, and 11 were described by the grantees as having both capacity and research/evaluation components.

Examples of the impact of completed extramural programs included:

- Documenting an 80% increased risk of falling among seniors taking certain psychotropic medications with elimination half-lives greater than 24 hours (OR 1.8, 95% CI 1.3-2.4), compared to medications with shorter half-lives.
- Implementing a fall prevention intervention in nursing homes that reduced falls up to 46% among patients who had previously fallen, and that reduced fall-related injuries by 31.2%.
- Designing a flooring material that reduced the peak force on the femoral neck during a fall by 15.2% and which potentially could reduce hip fractures by as much as 50%.
- Providing information about injury prevention to 638,000 people including health care professionals, caregivers, and seniors through a web-based National Resource Center.
- Developing an award-winning training video about fall prevention that has been used to train at least 10,000 people nationwide.

Other research projects included: a study of the biomechanics of slips; improving balance; footwear and falls; injury prevention in long-term care facilities; fracture biomechanics; evaluation of task-specific training; international conference on hip protectors; evaluating Tai Chi programs; risk factors for fractures; pharmacy interventions; statewide fall prevention program evaluations; benefits of geriatric fall prevention clinics; and hip protector use in the community.

Nearly half of the extramural research projects resulted in at least one publication. Regardless of project type, the earlier in the funding cycle that a project was funded, the more likely it was to have some published results. Projects that received $750,000 or more produced the largest number of publications. However, outputs other than publications also were produced (such as training programs and Congressional testimony), primarily by Cooperative Agreement grantees. In addition, media appearances and presentations in various settings (e.g., conferences, community forums) were common, and grantees identified at least 45 distinct follow-on grants and contracts worth $22.6 million in the aggregate as a measure of sustainability.

Nineteen of the extramural projects reported a total of 287 distinct capacity building activities, and nearly one-half of these activities involved forming collaborations among community members, academia, practitioners, and others. Twenty seven projects trained a total of 3,421 students, fellows, organizational staff, public health workers, volunteers, and others. A total of 670 minorities were trained in fall prevention research (20% of all trainees) with an average of 56 minority trainees per project. Among the cooperative agreement projects funded, capacity building activities were most prevalent as well as projects that focused on intervention and dissemination research.

Projects also had an impact on policies and programs. Six projects developed a total of 13 policy resolutions on fall prevention for professional organizations or legal bodies. Twenty-two of the extramural projects (63%) developed a total of 82 new products for fall prevention, including research instruments, state-wide plans, checklists, educational modules, tool kits, and guidelines.

Assessments of the quality of the research portfolio were complicated because the projects focused on a range of activities and produced a variety of products. A bibliometric analysis provided good indicators of quality and impact through quantifying the patterns and influence of publications, number of citations, and counts of other research products such as the number of educational products. From 1986 to the present, extramural grantees reported 82 publications, or four publications per year on average from the portfolio, and 2.3 publications on average per project. Of these, 69 publications were in peer-reviewed journals, nine were book chapters or books, three publications were newsletter articles, and one was a letter to the editor. There were 65 extramural articles for which "times cited" information was available. These articles were cited 2,649 times, or an average of 41 times per article. The average impact factor for extramural articles published was 3.05 (0.75-28.66).

6. Discussion

6.1. Intramural Researchers' Observations

While there are some evidence-based older adult fall prevention interventions available (Rubenstein et al., 2003; Stevens & Sogolow, 2008), many remain unused or are infeasible to implement. Resources are needed to refine these strategies for populations with differing characteristics, to promote these strategies, to conduct research on the dissemination of these strategies, and to facilitate leadership in implementing these strategies at the federal, state, and local levels.

For surveillance, there is a need to determine the frequency of fall injuries and associated International Classification of Diseases diagnoses among older adults hospitalized for falls, collect information about circumstances of falls in medical records, and develop surveillance systems and databases that can provide state-specific estimates of nonfatal fall injuries. There is also a need to further analyze questions on falls included in Behavioral Risk Factor Surveillance System (BRFSS) and other surveillance tools (e.g., CDC's Injury Control and Risk Factor Survey) to track trends and measure change.

There is a need to identify fundamental causes of gender, ethnic, and racial differences and disparity in fatal and nonfatal fall rates, to ascertain underlying causes and/or circumstances of falls and fall-injuries and the differences between risk factors for men and women, to investigate whether the risk factors for injurious falls differ from the risk factors for non-injurious falls, and to assess protective factors related to preventing falls.

Research is needed on tailoring interventions for population subgroups with differing characteristics (e.g., racial, ethnic) and with different risk factors (e.g., chronic conditions, functional limitations). Factor analyses should be conducted of multicomponent fall interventions to determine what critical components of the intervention must be replicated in dissemination.

There is a need to determine intensity, duration, and dosage of exercise as a primary prevention strategy to prevent falls in

healthy seniors, and to assess the effectiveness of various types of exercise interventions. Research is needed on compliance with therapeutic regimes to reduce falls (i.e., reduction in psychoactive medication use and maintenance of physical activity). Research should be conducted to establish standardized definitions of falls and other outcome measures and to determine if and how environmental modifications can be made more effective. There is also a need to determine the effectiveness of policy changes that promote clinical assessments for seniors at high risk of falling, and to study the effectiveness of counseling and referral.

Older adult fall prevention research is needed on the best ways for interventions to be translated into community programs. Specifically, there is a need to evaluate fall prevention programs to document outcomes and to provide this feedback so that programs can be adapted and tailored for specific settings. The costs and cost-effectiveness of implementing these programs requires additional research. Research should also be conducted on how to effectively communicate fall prevention information to older adults in a way that encourages behavioral and environmental change.

6.2. Extramural Grantee Observations

Extramural grantees were asked to respond to a question about opportunities and needs in older adult fall prevention research. Not all grantees responded but of those that did, two major themes emerged: (a) more research is needed about how to best disseminate evidence-based, effective interventions, and (b) there is a substantial need to better understand and promote physical activity as an intervention.

Grantees also called for more research across all phases of the public health model. They called for foundational research into gender differences in fall risk factors and impacts. They also called for research on the differences in the rates and causes of falls in urban and rural environments, causal explanations for the protective influence of physical activity, research into why falls occur at some points in time and not others, and how cognitive and psychological factors interact with physical abilities to influence the risk of falls.

Grantees indicated that developmental efforts are needed: to study the efficacy of walking as a fall intervention; to study the validity of laboratory measures to reflect balance and mobility during daily activities; to develop environmental aids that are cost-effective and user friendly; and to study interventions that work within current systems and cultures. Grantees also called for efficacy and effectiveness research using studies that are large enough to test the effect of interventions on fall-related injuries rather than just falls themselves and studies on standards for hip protectors.

However, the opportunities for future research identified by grantees were overwhelmingly focused on dissemination research. Grantees called for research into marketing hip protectors; research on enhancing older adults' involvement in, and compliance with, intervention programs that are proven effective; research on why exercise-based fall prevention programs are not more widely available; and research on using social marketing to promote effective interventions. They also called for research into how to change health care systems and provider behavior, how to increase implementation of clinical interventions, and the involvement of trauma systems. Some researchers even called for greater implementation of community programs and systems of care that might prevent falls, and in developing a compendium of effective fall prevention strategies.

7. Recommendations from the Peer Review Panel

Recommendations represent the views of the panelists and are not necessarily those of the CDC. The peer review panel was asked to review the portfolio data and make recommendations for the future of research in older adult fall prevention. General recommendations were made followed by recommendations grouped according to the phases in the public health model.

7.1. General Recommendations

The panel concluded that the research portfolio projects were appropriate to the mission of CDC, coordinated, and evenly distributed across the four phases of the public health model. The work is well-respected internationally, has provided a foundation for other studies, and has generated a high level of interest in the field, worldwide. Three major evaluation themes emerged from the peer review panel's observations and discussions: (a) funding and resource allocations for older adult fall prevention research, (b) collaboration among federal and non-federal agencies and organizations, and (c) tracking and project reporting requirements.

7.1.1. Funding and Resource Allocation

Funding levels dedicated to research on older adult falls should be comparable to the burden of the problem, costs of care, emerging older adult population, and prevention potential. The percentage of dollars for this research should be increased to accurately reflect the national public health burden of older adult falls. Costs, disabilities, premature deaths, hospitalizations and other measures should be used to determine the level of increased funding and to maintain stability of the research dollars over time. The amount of money now spent on fall research by the 12 CDC-funded Injury Control Research Centers is insufficient considering the burden of the problem and the amount of money available to the ICRCs.

Falls is one area where the public burden is high and the benefit of prevention is great. Qualitative research should be added to the portfolio, which will enable NCIPC to understand more about the sustainability of fall prevention strategies, adherence to exercise and medication regimens, factors influencing decisions to enter and remain in a fall prevention program, or to wear hip protectors. It is not enough to know what seniors *should do* to reduce risk, but also important to know what they *will* do, and why. The current staffing level allocated to fall prevention research at NCIPC is insufficient for a problem this important.

7.1.2. Increased Collaboration

CDC would benefit from increased collaborations among agencies and organizations that routinely engage in research and programs related to older adults' health and fall prevention. CDC could develop, coordinate, and lead an interagency working group on fall prevention or researchers from organizations conducting studies. Members of the group could include the Veterans Administration, National Institute on Aging, Centers for Medicare and Medicaid Services (CMS), National Coalition for Physical Activity and Disability, NCHS, U.S. Administration on Aging (AoA), National Center for Medical Rehabilitation Research, and other agencies and private organizations. NCIPC should use the interest and current national momentum on fall prevention to solicit quality proposals and to strengthen its research agenda. Opportunities to develop public-private partnerships should be explored. Collaboration with secondary and tertiary prevention agencies was not apparent in the portfolio, but could strengthen the research on adverse outcomes of falls as part of the continuum of care for fall injuries. Additionally, such agencies potentially could co-sponsor research requests for proposals (RFPs) and provide sites for intervention implementation.

7.1.3. Project Tracking and Reporting

Standardized procedures and systems for collecting project-related outcome data, and the quality of projects conducted is needed for all funded research. This might include interim reports, final reports, project summaries, and other documentation and syntheses. By their nature, cooperative agreements received the most frequent monitoring because of the close involvement with staff scientists at NCIPC. Electronic tracking and reporting systems would help accomplish these goals.

7.2. Recommendations by Phases in the Public Health Model

7.2.1. Problem Definition

- There is a lack of good epidemiological data on trends and patterns of fall-related injuries on a state, regional, and national level with which to set baselines and establish targets for reduction. This should reflect mortality and morbidity data from vital statistics, ICD-9/10 hospital discharge data, and emergency department data.
- Collaborations with rehabilitation agencies should be enhanced to strengthen secondary and tertiary prevention efforts related to falls among older adults. Partnerships should be used to help reduce adverse outcomes among older adults throughout the continuum of care for fall injuries.
- State data should be compiled, analyzed, and compared to determine whether sociodemographic, economic, racial/ethnic, or other patterns are the cause of the tremendous disparities among states in fall death and hospitalization rates. The data analysis should be disseminated as a "report card" (similar to one developed for Canadian Provinces) so states can compete in preventing falls and reducing morbidity and mortality from fall injuries.
- More studies are needed on the economic burden of fall injuries and reasons for the rise in fall death rates.
- Standardized outcome measures should be developed for fall prevention research projects, such as common criteria to define "*falls*" and "*fall injuries*."
- CDC should house a national fall surveillance database.
- The State and Territorial Injury Prevention Directors Association (STIPDA) passed consensus recommendations on surveillance of falls and fall-related injuries, which should be used to encourage states to generate relevant local data in assessing the problem and potential solutions.

7.2.2. Risk Factor Identification

- Research should be conducted to identify environmental, community, and individual variables that are related to fall risk factors and remediation among older adults. The current literature on risk factors by setting or sub-population should be reviewed in this effort to identify and fill gaps, and to tailor interventions to the specific setting or individual.
- Human factors of aging should be incorporated into research designs of studies on the environment as it relates to fall prevention.
- Strategies should be created to access existing data systems and to obtain more complete risk factor data on falls among older adults.
- Some emergency medical services, private physicians' offices, Medicare billing data, and fire departments maintain information on falls among older adults. The Injury Center could assist by funding the coordination and linkage among these databases.
- The Medicare Current Beneficiary Survey (MCBS), an in-person longitudinal survey with national representation of ~16,000 persons, is linked to Medicare claims data and has followed individuals for nearly 20 years. NCIPC could tailor fall questions for the MCBS survey and collaborate with MCBM staff to analyze existing data on fall risk and protective factors.
- CMS has awarded funds to a quality improvement organization that maintains national data on colorectal screening rates among Medicare beneficiaries. This model could be replicated for fall screening rates in the Medicare population.

7.2.3. Developing and Testing Interventions

- Persons $\geq$65 years of age should be stratified in fall prevention research activities because this population is not homogenous. Separate interventions should be developed for different age groups based on level of frailty, residence in an acute, residential, or community setting, and other factors.
- Innovative interventions for fall prevention should continue to be funded and tested (e.g., adding fall prevention education to routine health visits).
- Opportunities to conduct multi-site studies of well-developed and promising interventions should be explored.
- A multi-site RCT, multi-agency initiative, or other similar mechanism should be considered to build a research framework for answering multiple questions in various sites simultaneously.
- A partnership should be established with NIH and the VA to compare falls among the elderly in hospitals, nursing homes, or other small units in the community.

- Research on the cost effectiveness, benefit, utility, and savings of fall prevention interventions should be compiled to fill research gaps in these areas. The economic analysis should be widely disseminated to assist other federal agencies in making a strong case for more fall prevention research dollars.
- Studies should be designed that focus on hip protectors, affordable flooring materials, and other devices that minimize the impact of injuries among older adults who fall.
- Studies should be funded to test the effectiveness of interventions such as Tai Chi, mobility and balance, medication compliance, and other fall prevention strategies.

7.2.4. Translation and Dissemination

- Translational and dissemination research is needed on the best ways to increase uptake and adoption of fall prevention strategies. Coalitions should be engaged in this effort. Training, support, and collaboration should be fostered with occupational physical therapists and other health provider specialists. Pre-grant workshops, conferences, or web-based seminars on translation research should be held to improve proposals submitted in response to funding announcements.
- A national fall prevention education program is needed for health care professionals and those in community organizations serving seniors.
- Current assessment methodologies should be translated into dissemination projects because these initiatives are now substantiated by evidence, have established capacity, and are well poised for funding.
- Research should be conducted that focuses on recruiting and retaining cohorts in fall prevention dissemination studies.
- Existing data sets, training programs, and curricula with a demonstrated track record of effectiveness should be reviewed in translating and disseminating fall prevention research findings.

8. Conclusions

The Injury Center at CDC has played a central role in contributing to current knowledge about epidemiology and prevention of older adult falls. Results from this peer review indicated that CDC's older adult fall prevention research portfolio: (a) has been well designed and executed; (b) has directed resources appropriately toward identified problems and programs; (c) has targeted issues relevant to the research agenda and Healthy People 2010 goals; and (d) has been directed toward significantly reducing older adult falls, nationwide.

However, many gaps still exist, creating opportunities for the Injury Center to conduct further research and to expand and apply what's known to prevent older adult falls. Additional research is needed to: (a) identify fundamental causes of gender, ethnic, and racial differences and disparity in fatal and nonfatal fall rates; (b) develop and test interventions tailored for population subgroups with differing characteristics and with different risk factors; and (c) translate and disseminate evidence-based interventions. Non-research activities are needed to:

- Develop collaborative projects to leverage scarce resources with other federal and non-federal agencies;
- Increase NCIPC scientific and program staff and resources commensurate with the public health burden of falls and the benefits accrued for prevention.

Since conducting this review, the Injury Center at CDC has responded to a number of suggestions from the review to address important gaps in older adult fall prevention. Research into gender, ethnic, and racial differences in falls has begun. Using national data, analyses have been conducted of gender differences in falls and fall injuries; seasonal patterns of fatal and nonfatal fall injuries; and the incidence of self-reported recent falls among respondents to the Behavioral Risk Factor Surveillance Survey (Stevens et al., 2008). In collaboration with the Centers for Medicare and Medicaid Services, NCIPC is examining falls and associated costs among Medicare recipients using data from the MCBS and has conducted an initial analysis examining fall incidence and gender differences. Additionally, we have outlined a series of additional research questions to examine with these data, including the relationship between falls and activities of daily living, physical activity, chronic conditions, and prescription medication use.

The Injury Center has funded the translation of a proven Tai Chi fall intervention into a community-based program, *Moving for Better Balance,* in Oregon (Li et al., 2008, in press). This program is now being broadly disseminated statewide with funding from AoA. CDC recently funded a knowledge translation project involving the adaptation of a proven-effective Australian fall prevention program ("Stepping On") for application in U.S. community based settings, and NCIPC has developed a compendium of evidence-based fall prevention strategies (Stevens & Sogolow, 2008) to address this gap.

Greater collaboration has been established with both AoA and the National Council on Aging (NCOA). Through a new Interagency Agreement with AoA, NCIPC is contributing to the falls initiative, spearheaded by NCOA, and supporting the activities of the *Falls Free Coalition,* which is addressing older adult falls through the implementation of the *Falls Free National Action Plan*.

With the support of *Falls Free Coalition* members and other non-federal partners, the *Keeping Seniors Safe from Falls Act of 2007*, a bill to direct the Secretary of Health and Human Services to expand and intensify programs with respect to research and related activities concerning older adult falls, was recently passed by both the U.S. Senate and the House of Representatives, and signed by President Bush.

9. Future Directions

The U.S. population is aging rapidly. By 2020, one in six Americans will be 65 or older (U.S. Census Bureau, 2006). As the number of older adults increases, the number of fall-related injuries and fatalities will also increase. This research portfolio evaluation has uncovered a number of promising directions for future research, including observations from CDC intramural researchers, extramural grantees, and from the portfolio review panel. General recommendations are related to funding and resource allocation, increased collaboration, and project

tracking. Research recommendations were specifically tied to the four stages of the public health model, and included suggestions for improving research addressing problem definition (surveillance), risk factor identification, intervention development and testing, and translation and dissemination.

There is every indication that the CDC's investments in fall prevention research has led to important progress, despite limited resources. CDC is poised to broadly implement some of the recommendations in this report, and refine its fall prevention research portfolio accordingly to achieve greater impact. Continued work at the CDC's Injury Center will be needed to (a) achieve wider dissemination and use of effective injury prevention programs, and (b) create linkages and partnerships with aging services, trauma care/health systems, and government and non-government agencies and the private sector to leverage scarce resources. Reducing the burden of fall injuries on society will require the implementation of these and other strategies in the future.

10. Disclaimer

The views expressed in this article are those of the authors, and do not necessarily represent the official views of CDC.

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