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Interventions to Promote Health and Increase Health Care Efficiency: *April 2018 Update*

The Washington State Legislature directed the Washington State Institute for Public Policy (WSIPP) to "calculate the return on investment to taxpayers from evidence-based prevention and intervention programs and policies."[1] In continuing this effort, WSIPP's Board of Directors authorized WSIPP to work on a joint project with the MacArthur Foundation and the Pew Charitable Trusts Results First Initiative. This project extended WSIPP's benefit-cost analysis to a variety of new topics, including health care programs.[1]

In this report, we present findings on interventions to promote health and increase health care efficiency for older adults and/or their informal caregivers. We consulted with Washington State stakeholders to identify specific interventions for review.

In Section I we describe our research approach. In Section II we discuss findings for interventions in two areas:[2]

1) Interventions to prevent falls and
2) Interventions for older adults with dementia and/or their caregivers.

We describe whether the interventions achieve effects on desired outcomes, and, if so, the magnitudes of those effects. We present benefit-cost results for these interventions, when possible.

Summary

In 2015, WSIPP's Board of Directors authorized WSIPP to work on a joint project with the MacArthur Foundation and the Pew Charitable Trusts to extend WSIPP's benefit-cost analysis to select health care topics.

We present new benefit-cost findings for interventions to promote health and increase health care efficiency for older adults, including:

1) Interventions to prevent falls and
2) Interventions for older adults with dementia and/or their caregivers.

For each topic, we gathered all credible evaluations we could locate. We screened the studies for methodological rigor and computed an average effect of the programs on specific outcomes. When possible, we calculated benefits and costs and conducted a risk analysis to determine which programs consistently have expected benefits that exceed costs.

We find that some approaches can achieve benefits that consistently exceed costs but others do not. We describe these findings in this report and display them in Exhibits 3-5.

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[1] Engrossed Substitute House Bill 1244, Chapter 564, Laws of 2009.
[2] Please see our website for findings on other health care topics.

Research Methods

The Washington State Legislature or WSIPP's Board of Directors often directs WSIPP to assess the effectiveness and benefits and costs of programs and policies that could be implemented in Washington State. These studies are designed to provide policymakers with objective information about which programs or policy options ("programs" or "interventions") work to achieve desired outcomes and what the long-term economic consequences of these options are likely to be.

WSIPP implements a rigorous, three-step research approach for this type of study:

1) Identify what works (and what does not). For each program under consideration, we systematically review all rigorous research evidence and estimate the program's effect on a desired outcome or set of outcomes. The evidence may indicate that a program worked (i.e. had a desirable effect on outcomes), caused harm (i.e. had an undesirable effect on outcomes), or had no detectable effect.

2) Assess the return on investment. Given the estimated effect of a program from Step 1, we estimate—in dollars and cents—how much the program would benefit people in Washington were it implemented and how much it would cost the taxpayers to achieve this result. We use WSIPP's benefit-cost model to develop standardized, comparable results for all programs that illustrate the expected returns on investment. We present these results as net present values on a per-participant basis. We also consider how monetary benefits are distributed across program participants, taxpayers, and other people in society.

3) Determine the risk of investment. We allow for uncertainty in our estimates by calculating the probability that a program will at least "break even" if critical factors—like the actual cost to implement the program and the precise effect of the program—are lower or higher than our estimates.

We follow a set of standardized procedures (see Exhibit 1) for each of these steps. These standardized procedures support the rigor of our analysis and allow programs to be compared on an "apples-to-apples" basis.

In some cases, we are unable to assess the return on investment and the risk of investment (Steps 2 & 3). We do not conduct these steps if there is only one rigorous evaluation or if we are unable to estimate benefits and costs of the program. In these cases, we report meta-analytic results only.

For full detail on WSIPP's methods, see WSIPP's Technical Documentation.[3]

[3] Washington State Institute for Public Policy (December 2017). *Benefit-cost technical documentation*. Olympia, WA: Author.

Exhibit 1

WSIPP's Three-Step Approach

Step 1: Identify what works (and what does not)

We conduct a meta-analysis—a quantitative review of the research literature—to determine if the weight of the research evidence indicates whether desired outcomes are achieved, on average.

WSIPP follows several key protocols to ensure a rigorous analysis for each program examined. We:

- Search for all studies on a topic—We systematically review the national and international research literature and consider all available studies on a program, regardless of their findings. That is, we do not "cherry pick" studies to include in our analysis.
- Screen studies for quality—We only include rigorous studies in our analysis. We require that a study reasonably attempt to demonstrate causality using appropriate statistical techniques. For example, studies must include both treatment and comparison groups with an intent-to-treat analysis. Studies that do not meet our minimum standards are excluded from analysis.
- Determine the average effect size—We use a formal set of statistical procedures to calculate an average effect size for each outcome, which indicates the expected magnitude of change caused by the program (e.g., group exercise programs) for each outcome of interest (e.g., rate of falls).

Step 2: Assess the return on investment

WSIPP has developed, and continues to refine, an economic model to provide internally consistent monetary valuations of the benefits and costs of each program on a per-participant basis.

Benefits to individuals and society may stem from multiple sources. For example, a program that reduces the need for publicly funded health care services decreases taxpayer costs. If that program also improves participants' educational outcomes, it will increase their expected labor market earnings. Finally, if a program reduces crime, it will also reduce expected costs to crime victims.

We also estimate the cost required to implement an intervention. If the program is operating in Washington State, our preferred method is to obtain the service delivery and administrative costs from state or local agencies. When this approach is not possible, we estimate costs using the research literature, using estimates provided by program developers, or using a variety of sources to construct our own cost estimate.

Step 3: Determine the risk of investment

Any tabulation of benefits and costs involves a degree of uncertainty about the inputs used in the analysis, as well as the bottom-line estimates. An assessment of risk is expected in any investment analysis, whether in the private or public sector.

To assess the riskiness of our conclusions, we look at thousands of different scenarios through a Monte Carlo simulation. In each scenario we vary a number of key factors in our calculations (e.g., expected effect sizes, program costs), using estimates of error around each factor. The purpose of this analysis is to determine the probability that a particular program or policy will produce benefits that are equal to or greater than costs if the real-world conditions are different than our baseline assumptions.

Interventions Reviewed

The current report presents meta-analytic and benefit-cost findings for select interventions to promote health and increase health care efficiency for older adults and/or their informal caregivers.

We consulted with legislative and state agency staff in Washington State to inform the scope of our analyses, including the interventions and populations considered for review. Over the past few decades, Washington State has been part of a national trend of shifting Medicaid spending on long-term services and supports away from long-term care facility services and toward home- and community-based services.[4] Due to this shift, community-dwelling older adults are a population of particular interest for stakeholders in Washington State. We focused our reviews on interventions for community-dwelling older adults and their informal caregivers.

We define "community-dwelling older adults" as adults age 65 or older who are living in the community and not in long-term care facilities. These individuals may live at home or in independent senior living facilities. Informal caregivers are typically family members or friends, who may assist an older adult in activities of daily living[5] and/or by providing emotional support.

We identified two priority topic areas:

1) Interventions to prevent falls and
2) Interventions for older adults with dementia and/or their caregivers.

Brief descriptions of each intervention reviewed can be found in Section II.

For interventions to prevent falls, we conducted a full benefit-cost analysis when possible. For interventions for older adults with dementia and/or their caregivers, we report meta-analytic results only. We describe the details in Section II.

Outcomes Examined

Evaluations of the interventions reviewed in this report typically measure outcomes that reflect the health status of people and/or the use of health care resources.[6] Our analytic approach captures both types of outcomes. We include the following outcomes for interventions reviewed in this report:

- Falls,
- Depression,
- Caregiver burden,
- Cognitive functioning,
- Fall-related hospitalizations,
- Emergency department visits,
- Health care costs, and
- Mortality.

The specific outcomes captured, meta-analyzed, and monetized vary by intervention and are discussed more completely within each relevant section of this report.

[4] Xing, J., Mancuso, D., & Felver, B. (2018). *The changing patterns of long-term services and supports use in Washington State* (RDA REPORT 8.34), Olympia, Washington.

[5] Activities of daily living (ADLs) are routine activities of self-care that adults can typically perform without assistance. ADLs may include bathing, dressing, personal hygiene, toilet hygiene, and feeding oneself.

[6] Cost and utilization measures may or may not be an indication of health status or well-being.

II. Research Findings

This section presents new findings for two broad topic areas:

1) Interventions to prevent falls and
2) Interventions for older adults with dementia and/or their caregivers.

For each topic area, we present relevant considerations and an exhibit displaying meta-analytic and benefit-cost findings (when possible) for the programs reviewed. The studies used in our analyses are listed in Appendix II.

A description of how to read the benefit-cost exhibits is provided in Exhibit 2 below.

Exhibit 2

How to Interpret WSIPPs Benefit-Cost Results (Exhibit 4)

The numbered columns on the benefit-cost exhibits are described below.

1) Program name describes the name of the intervention analyzed. Some programs are general categories of a type of intervention, while others are specific name-brand programs. Descriptions of each program can be found following each exhibit, as well as on our website.[#]
2) Total benefits are the average benefits of the intervention, per-participant. This is the sum of the taxpayer and non-taxpayer benefits.
3) Taxpayer benefits are benefits that accrue to the taxpayers of the state of Washington through avoided publicly funded health care system costs and/or taxes participants would pay on their increased labor market earnings.
4) Non-taxpayer benefits include benefits that accrue directly to program participants; benefits to others, such as reduced costs to private health insurance providers; and indirect benefits, such as the value of a statistical life and the deadweight costs of taxation.
5) Costs are the estimated per-participant cost to implement the program in Washington, relative to the cost of treatment as usual. If the cost is positive, the intervention is estimated to be cheaper than the treatment as usual.
6) Benefits minus costs (net present value) are the net benefits, or the difference between the total benefits and the cost to implement the program, per participant. If this number is positive, the expected benefits of the program exceed the estimated cost. If this number is negative, the program is estimated to cost more than the sum of the expected benefits.
7) Benefit to cost ratio represents the estimated value to Washington State for each dollar invested in the program. It is the total benefits divided by the cost of the program. If a program cost is positive, the benefit-to-cost ratio is designated as "n/a"—not applicable.
8) Chance benefits will exceed costs describes the risk of the investment. In our benefit-cost analysis, we account for uncertainty in our estimates by allowing key inputs to vary across thousands of scenarios. We run our benefit-cost model 10,000 times; this statistic shows the percentage of cases in which the total benefits were greater than the costs.

Note:

[#] The benefit-cost section of WSIPP's website presents our current findings for a variety of public policy topics. Items on these tables are updated periodically as new information becomes available. Interested readers can find more information by clicking each entry in the tables.

1) Interventions to Prevent Falls

Falls are a major cause of morbidity and mortality among older adults[7] and are the leading cause of injury-related death among adults age 65 and older in Washington State.[8] In 2014, 32% of older adults in Washington fell at least once.[9] Older adults who fall have an increased likelihood of hospitalization and death compared to older adults who do not fall.[10]

Risk of falling increases with age. In Washington, older adults aged 65-69 experience 0.61 falls per person per year, while older adults over age 80 experience 0.69 falls per person per year.[11] The incidence rate of falls is even greater among older adults with additional risk factors for falls.[12]

Falls prevention interventions typically aim to reduce fall rates by targeting one or more risk factors for falls, such as poor balance or environmental hazards. We examined interventions that aim to prevent falls among community-dwelling older adults, [13] including:

1) Exercise;
2) Home hazard reduction;
3) Cognitive behavioral interventions;
4) Multicomponent interventions; and
5) Multifactorial interventions.

We examined falls prevention interventions for two populations: 1) older adults from a general population and 2) older adults at high risk for falls.[14] We report results separately for these populations.[15] We also analyze exercise interventions for older adults with osteoporosis or osteopenia.[16]

[7] Rubenstein, L.Z., & Josephson, K.R. (2002). The epidemiology of falls and syncope. *Clinics in geriatric medicine, 18*(2), 141-158.
[8] Washington State Department of Health (n.d.) Older Adult Falls. Retrieved March 19, 2018.
[9] Bergen, G., Stevens, M.R., & Burns, E.R. (2016). Falls and fall injuries among adults aged≥ 65 years—United States, 2014. U.S. Centers for Disease Control and Prevention. *Morbidity and mortality weekly report, 65*.
[10] Washington State Department of Health (n.d.) Older Adult Falls. Retrieved March 19, 2018.
[11] Fall rates for Washington were estimated using 2012, 2014, and 2016 data from the Behavioral Risk Factor Surveillance System Survey Data. See WSIPP's Technical Documentation for additional detail. WSIPP (2017).
[12] Common risk factors for falls include previous falls history, impaired gait, muscle weakness, visual impairment, and recent hospital discharge.
[13] As described in Section I, we focus on older adults who live in the community (i.e., not in acute care settings or long-term care facilities). We did not examine interventions for older adults with a specific medical conditions (e.g. Parkinson's disease or multiple sclerosis), with the exception of osteoporosis/osteopenia.
[14] We classified populations as "high-risk" if interventions selected participants due to the presence of falls risk factors. Risk factors may include previous falls history, impaired gait, muscle weakness, visual impairment, or recent hospital discharge.
[15] We model different expected incidence rates of falls for older adults in a general population compared to older adults in a high-risk population. See WSIPP's Technical Documentation for details. WSIPP (2017).
[16] Osteoporosis and osteopenia are conditions characterized by bone loss. Osteoporosis refers to severe bone loss, which the World Health Organization defines as bone mineral density 2.5 standard deviations lower than normal. Kanis, J.A., McCloskey, E.V., Johansson, H., Oden, A., Melton, L.J. 3rd, Khaltaev N.A. (2008). Reference standard for the description of osteoporosis. *Bone 42*(3), 467–75. Osteopenia refers to bone loss (lower than normal bone density) that is not as severe as osteoporosis.

In our analyses, we report an incidence rate ratio (IRR) for falls outcomes, rather than a standardized mean difference effect size, to capture changes in the incidence rates of falls.[17] Incidence rates of falls represent the number of falls in a given time period. An IRR is the ratio of the incidence rate in the group receiving the intervention to the incidence rate in the comparison group. An IRR less than one indicates a lower rate of the outcome (i.e., a lower rate of falls) in the treatment group relative to the comparison group; an IRR greater than one indicates a higher rate of the outcome.

The measured outcome that drives the benefit-cost results for these interventions is the IRR of falls. Changes in the IRR of falls result in: 1) changes in health care utilization costs due to changes in fall-related hospitalization rates and 2) changes in the value of future statistical life years due to changes in fall-related mortality. For example, if an exercise program for older adults reduces the rate of falls among participants, then a participant would be expected to have a lower likelihood of hospitalization (and therefore have lower health care costs) and live longer, on average, than if they had not participated in the program. Our benefit-cost model monetizes both of these benefits.

Exhibit 3 provides our meta-analytic results for these interventions and Exhibit 4 provides benefit-cost findings. We typically do not estimate benefits and costs for interventions that have only one rigorous evaluation, unless that evaluation is from Washington State. Following the exhibits, we provide short descriptions of the interventions reviewed and our findings.

[17] See WSIPP's Technical Documentation for a thorough description of these methods. WSIPP (2017).

Exhibit 3

Meta-Analytic Results: Falls Prevention Interventions

Intervention	Outcome	Avg. age	# of effect sizes	# in treatment	Effect size	SE	p-value
Group exercise classes (general population)	Falls*	74	4	306	0.856	0.070	0.057
Group exercise classes for osteoporosis/osteopenia	Falls*	72	3	237	0.757	0.118	0.071
Group exercise classes (high-risk population)	Falls*	75	3	226	0.821	0.240	0.480
Individual exercise programs (general population)	Falls*	74	2	205	0.749	0.212	0.284
Individual exercise programs for osteoporosis/osteopenia	Falls*	69	1	49	0.432	0.222	0.064
Individual exercise programs (high-risk population)	Falls*	81	6	602	0.907	0.094	0.343
Tai Chi (general population)	Falls*	72	2	91	0.593	0.092	0.001
Tai Chi (high-risk population)	Falls*	79	2	259	0.919	0.229	0.725
Otago Exercise Program (general population)	Falls*	82	2	225	0.638	0.064	0.001
Otago Exercise Program (high-risk population)	Falls*	83	1	92	0.784	0.097	0.047
Home hazard reduction (general population)	Falls*	76	2	731	0.998	0.076	0.981
Home hazard reduction (high-risk population)	Falls*	75	3	498	0.586	0.091	0.001
	Fall-related hospitalization	75	1	30	0.000	0.344	1.000
Cognitive behavioral interventions (general population)	Falls*	78	2	384	0.860	0.045	0.004
Multicomponent interventions including exercise and home hazard reduction (general population)	Falls*	76	1	173	0.734	0.079	0.004
Multicomponent interventions including exercise and home hazard reduction (high-risk population)	Falls*	83	1	92	0.709	0.090	0.006
Multicomponent interventions including exercise and vitamin D supplementation (high-risk population)	Falls*	74	1	194	1.006	0.094	0.949
Multifactorial intervention: physician-led (high-risk population)	Falls*	79	2	278	0.675	0.047	0.001
	Fall-related hospitalization	79	2	369	0.030	0.092	0.741
	Emergency department visits	79	1	159	-0.079	0.184	0.668
Multifactorial intervention: nurse-led (general population)	Falls*	76	1	222	0.752	0.058	0.001
Multifactorial intervention: nurse-led (high risk population)	Falls*	83	2	1,037	1.155	0.036	0.001
	Fall-related hospitalization	83	1	136	-0.361	0.194	0.062

Notes:

These results are current as of April 2018. More recent results may be available on WSIPP's website.

*The effect size for this outcome indicates an incidence rate ratio (IRR), not a standardized mean difference effect size. An IRR less than one indicates a lower rate of the outcome in the treatment group relative to the comparison group; an IRR greater than one indicates a higher rate of the outcome. The "# in treatment" for this outcome represents person-years (number of individuals in treatment, multipled by the amount of time at risk for falls, in year).

Exhibit 4

Benefit-Cost Results: Falls Prevention Interventions

Program name (1)	Total benefits (2)	Taxpayer benefits (3)	Non-taxpayer benefits (4)	Costs (5)	Benefits minus costs (net present value) (6)	Benefit to cost ratio (7)	Chance benefits will exceed costs (8)
Group exercise classes (general population)	$170	$44	$126	($132)	**$38**	$1.29	**61%**
Group exercise classes for osteoporosis/osteopenia	$643	$144	$499	($297)	**$347**	$2.17	**79%**
Group exercise classes (high-risk population)	$2,948	$503	$2,446	($345)	**$2,603**	$8.54	**73%**
Individual exercise programs (general population)	$278	$76	$202	($267)	**$11**	$1.04	**50%**
Individual exercise programs (high-risk population)	$2,756	$345	$2,411	($580)	**$2,175**	$4.75	**76%**
Tai Chi (general population)	$523	$123	$399	($334)	**$189**	$1.57	**81%**
Tai Chi (high-risk population)	$523	$113	$410	($221)	**$302**	$2.37	**57%**
Otago Exercise Program (general population)	$3,590	$473	$3,117	($628)	**$2,963**	$5.72	**100%**
Home hazard reduction (general population)	($73)	$1	($74)	($157)	**($230)**	($0.47)	**17%**
Home hazard reduction (high-risk population)	$3,516	$584	$2,933	($318)	**$3,198**	$11.05	**100%**
Cognitive behavioral interventions (general population)	$259	$71	$188	($293)	**($34)**	$0.89	**42%**
Multifactorial interventions: physician-led (high-risk population)	$1,850	$458	$1,392	($1,504)	**$346**	$1.23	**65%**
Multifactorial intervention: nurse-led (general population)	$463	$126	$336	($666)	**($204)**	$0.69	**21%**
Multifactorial intervention: nurse-led (high-risk population)	($4,926)	($567)	($4,359)	($562)	**($5,488)**	($8.76)	**0%**

Note:
See Exhibit 2 for a description of how to read this exhibit of benefit-cost findings. These results are current as of April 2018. More recent results may be available on WSIPP's website.

Exercise interventions

Exercise interventions for falls prevention address risk factors related to imbalance, poor gait, and muscle weakness. The content of exercise interventions for falls prevention varies but often focuses on at least two of the following components: balance, gait, functional ability, strength, flexibility, general physical activity, and endurance. Exercise programs may be delivered in group classes or supervised individual sessions or may be "prescribed" for individual practice at home. We examined four types of exercise programs for community-dwelling older adults:

1) Group exercise classes,
2) Individual exercise programs,
3) Tai Chi, and
4) The Otago Exercise Program.

We separately analyze programs for general populations and high-risk populations. We also evaluate programs designed for older adults with osteoporosis/osteopenia.

Group exercise classes. This broad topic includes group exercises classes for falls prevention among community-dwelling older adults. These programs focus on building strength, increasing flexibility, and improving balance and gait. Classes are typically taught by fitness instructors in a community setting, such as a local gymnasium or community center.

We found four rigorous studies of group exercise programs for a general population. These programs provided 44 hours of exercise class over a period of five months on average, with a range of 15 to 154 total hours. We find evidence for a 15% lower rate of falls, on average, among participants in a group exercise program compared to non-participants. This translates to an expected reduction in the falls rate from 0.63 to 0.54 falls per person per year in a general population of a similar age in Washington State.[18] We find that, in this population, the expected benefits of group exercise classes exceed the costs of these programs 61% of the time, on average.

We found three rigorous studies that examined group exercise classes for older adults with osteoporosis/osteopenia. In these studies, physiotherapists or fitness instructors taught one or two classes per week at an athletic club or community center and in some cases assigned home-based exercises as well. Program length ranged from five months to 2.5 years, with a mean duration of 1.5 years. We find evidence for a 24% lower rate of falls, on average, among participants compared to non-participants. This translates to an expected reduction in the falls rate from 0.63 to 0.55 falls per person per year in a general population of a similar age in Washington State. We find that the expected benefits of these programs exceed program costs 79% of the time, on average.

We also found four rigorous studies on group exercise programs for older adults at high risk of falling. These programs provided 118 hours of exercise class over a period of 17 months on average, with a range of 24 to 156 total hours. We find evidence for an 18% lower rate of falls, on average, among participants compared to non-participants. This translates to an

[18] The expected rate of falls is based on the age-specific falls rate in the Washington State sample of the Behavioral Risk Factor Surveillance Survey (BRFSS), a national survey designed to provide valid state-level information about behavioral risk factors and health. See our Technical Documentation for additional detail on base rates for falls in general and high-risk populations. WSIPP (2017).

expected reduction in the falls rate from 1.70 to 1.40 falls per person per year in a high-risk population of a similar age in Washington State.[19] On average, we expect the benefits of these programs to outweigh the costs 73% of the time.

Individual exercise programs. Individual exercise programs for falls prevention may consist of a standardized program of exercise or an individually tailored plan. These programs typically include regular phone calls to participants to encourage adherence.

We found two rigorous evaluations of individual exercise programs for a general population. These programs were home-based and used video games or written manuals to deliver exercise instruction. Program length varied from 4 to 11 months. We find no evidence of an effect on the falls rate, on average. We expect the monetary benefits of these programs to outweigh costs 50% of the time.

We found one rigorous study of an individual exercise program for older adults with osteoporosis/osteopenia. In this program a physiotherapist supervised a one-year exercise program, consisting of three 30-minute outpatient sessions per week for each participant. For the rest of each week, participants were assigned home-based exercises daily for one hour. From this single study, we find no evidence of an effect on the falls rate.

We found six rigorous evaluations of individual exercise programs for older adults at high risk of falling. In these interventions, a physiotherapist or other provider assigned exercises and typically followed up with home visits and phone calls to monitor progress. The duration of these programs varied from 6 weeks to 1.3 years. On average, participants were prescribed 708 hours of exercise. We find no reliable effect on the falls rate, on average. However, we find that the overall expected benefits of these programs exceed costs 76% of the time for older adults at high risk for falls.

Tai Chi. Tai Chi (also known as Tai Qi or Tai Ji Quan) is a form of exercise that emphasizes balance, postural alignment, and coordinated movement. We examined evaluations of group Tai Chi classes for falls prevention among community-dwelling older adults. Classes were typically taught by a trained Tai Chi instructor in a community setting and included an average of ten participants per class.

We analyzed two rigorous studies of group Tai Chi classes in a general population of older adults. In these programs, classes were typically provided for one hour, three times per week for 3 to 12 months. On average, participants received 113 hours of total class time. We find evidence for a 41% lower rate of falls, on average, among participants in Tai Chi compared to non-participants. This translates to an expected reduction in the falls rate from 0.63 to 0.37 falls per person per year in a general population of a similar age in Washington State.[20] For this population, we expect the benefits of Tai Chi to exceed costs 81% of the time.
We also analyzed two rigorous studies of group Tai Chi classes for older adults with a high risk of falling. These programs typically provided classes for one hour, two times per week for 3 to 11 months. On average,

[19] Ibid.

[20] Ibid.

participants received 75 hours of total class time. We find no evidence of an effect on the falls rate, on average. We expect the benefits of Tai Chi to exceed costs 57% of the time in a high-risk population.

Otago Exercise Program. The Otago Exercise Program is an individually tailored, home-based, strength and balance retraining program for community-dwelling older adults. The goal of the Otago Exercise Program is to prevent falls. The program is typically provided by a physiotherapist who teaches the exercise program to participants in their homes and provides a "prescription" for the exercise program to be independently practiced three times per week. The exercises are tailored to participants' needs and capabilities and consist of strength and balance exercises using ankle cuff weights.

Physiotherapists typically provide four home visits over the first two months in the program and make monthly follow-up calls to participants through the next four months. All studies included in our analyses took place in New Zealand.

We analyzed two studies of the Otago Exercise Program in a general population of community-dwelling older adults. We find evidence for a 36% lower rate of falls, on average, among participants in the program compared to non-participants. This translates to an expected reduction in the falls rate from 0.69 to 0.44 falls per person per year in a general population of a similar age in Washington State.[21] We find that the expected benefits of the Otago Exercise Program exceed costs more than 99% of the time, in this population.

We also analyzed a single study on older adults at high risk for falls due to visual impairment. In this study, we find evidence for a 22% lower rate of falls among participants in the program compared to non-participants. This translates to an expected reduction in the falls rate from 1.91 to 1.50 falls per person per year in a high-risk population of a similar age in Washington State.[22]

Home hazard reduction

Home hazard reduction programs aim to prevent falls by facilitating modifications to the physical environment. In a typical program, an occupational therapist or other provider makes one or two home visits to assess hazards and assist with purchasing or installing modifications. Common modifications include removing or stabilizing rugs, elevating toilets, and installing bathroom grab bars.

We found two rigorous evaluations of home hazard reduction programs for general populations to include in our analysis. Based on these evaluations, we find no evidence of an effect on the falls rate, on average. We find that expected benefits exceed costs only 17% of the time.

We separately analyzed three evaluations of home hazard reduction programs for individuals with a high risk of falling. We find that these programs result in a 41% lower rate of falls, on average, among participants compared to non-participants. This translates to an expected reduction in the falls rate from 1.70 to 0.99 falls per person per year in a high-risk population of a similar age in Washington State.[23] For this

[21] Ibid.

[22] Ibid.
[23] Ibid

population, we expect home hazard reduction to produce positive net benefits more than 99% of the time.

Cognitive behavioral interventions

Cognitive behavioral interventions for falls prevention are designed to reduce the fear of falling and increase activity levels among older adults. Major components of these interventions include 1) identifying misconceptions about falls and improving self-efficacy; 2) setting realistic personal goals for increased activity levels; 3) changing the environment to reduce fall risk factors; and 4) promoting exercise to increase strength and balance.

We found two rigorous evaluations of cognitive behavioral interventions targeting a general population of older adults. These interventions served community-dwelling adults aged 70 and older, in either a group class or individual instruction. The interventions were delivered by nurses trained in geriatric care. The interventions included in this analysis are both modifications of the U.S.-developed Matter of Balance program and are set in the Netherlands. The two interventions provided on average eight sessions of cognitive behavioral intervention for an average of 12.5 hours of instruction delivered either through group classes at a community center or via home visits and telephone calls.

The two studies result in a 14% lower rate of falls, an average, among participants compared to non-participants. This translates to an expected reduction in the falls rate from 0.61 to 0.53 falls per person per year in a general population of a similar age in Washington State.[24] We find that benefits exceed costs 42% of the time.

Multicomponent interventions

Multicomponent interventions provide a fixed combination of two or more interventions designed to prevent falls. The same components are provided to all participants. We examined two multicomponent interventions:

1) Exercise and home hazard reduction and
2) Exercise and vitamin D supplementation.

Exercise and home hazard reduction. These interventions provide both an exercise program and a home hazard assessment. Exercise may be provided in group classes or assigned to individuals. Both exercise and home hazard interventions are described in prior sections of this report.

We found a single rigorous evaluation of an exercise and home hazard reduction program for a general population. Participants in this program received weekly group exercise classes for 15 weeks and a home assessment and hazard removal. The evaluation showed a 27% lower rate of falls among participants, compared to non-participants. This translates to an expected reduction in the falls rate from 0.61 to 0.45 falls per person per year in a general population of a similar age in Washington State.[25]

We also analyzed a single evaluation of an exercise and home hazard reduction program for individuals with a high risk of falling due to poor vision. Participants received one year of individualized home-

[24] Ibid.
[25] Ibid.

based exercises (the Otago Exercise Program) and a home assessment and assistance in hazard removal by an occupational therapist. This study showed a 29% lower rate of falls among participants, compared to non-participants. This translates to an expected reduction in the falls rate from 1.91 to 1.35 falls per person per year in a high risk population of a similar age in Washington State.[26]

Exercise and vitamin D supplementation. These interventions provide a combination of group or individual exercises along with daily vitamin D supplements, which together are intended to improve bone density and reduce the risk of falls and fractures.

We identified a single evaluation of an exercise and vitamin D program for a high-risk population that met our inclusion criteria. Participants received two years of group classes with a home exercise component. They also received one daily pill containing 800 IU of vitamin D3. We find no evidence for an effect of this intervention on the rate of falls.

Multifactorial interventions

Multifactorial falls prevention programs provide patients with a falls risk assessment followed by a combination of interventions tailored to needs identified during the assessment. The types of interventions recommended can include one or more of the following approaches: home modifications, education on health and safety, medication management, vision management, gait and balance training, and exercise. The disciplines providing these services can include occupational therapy, general medicine, physical therapy, nursing, and social services. We examined two types of multifactorial interventions:

1) Physician-led interventions and
2) Nurse-led interventions.

Physician-led interventions. These interventions begin with a comprehensive medical exam, which may be accompanied by assessments of some or all of the following: activities of daily living, home environment, behavior and cognition, gait stability, medications, and other elements. Most assessments take place in an outpatient setting. Patients are referred to one or more interventions to address the needs identified in these assessments.

We analyzed three rigorous studies of physician-led multifactorial interventions for a high-risk population. We find evidence for a 33% lower rate of falls, on average, among program participants compared to non-participants. This translates to an expected reduction in the falls rate from 1.70 to 1.15 falls per person per year in a high-risk population of a similar age in Washington State.[27] However, we find no evidence of an effect on the directly measured rates of fall-

[26] Ibid.

[27] Ibid.

related hospitalization, emergency department visits, or outpatient visits, on average. We find that the expected monetary benefits of physician-led interventions exceed costs 65% of the time.

Nurse-led interventions. Nurse-led multifactorial interventions begin with a basic risk assessment that typically takes place in the home. Based on this assessment, nurses may make referrals to other providers, such as a physician or physical therapist.

We found a single rigorous evaluation of a nurse-led multifactorial program for a general population of older adults—the Stay Active and Independent for Life (SAIL) program.[28] We find evidence for a 25% lower rate of falls among program participants, compared to non-participants. This translates to an expected reduction in the falls rate from 0.61 to 0.46 falls per person per year in a general population in Washington State.[29] From the evidence in this single study, we would expect benefits to exceed costs about 21% of the time.

We also analyzed three rigorous evaluations of nurse-led multifactorial programs for individuals at high risk for falls. We find that, on average, program participants experience a 16% higher rate of falls than non-participants. This translates to an expected increase in the falls rate from 1.91 to 2.21 falls per person per year in a high-risk population in Washington State.[30] However, one study found some evidence for a decrease in fall-related hospitalizations. In our benefit-cost analysis, we expect that nurse-led multifactorial programs for individuals at high-risk of falling will result in positive net benefits less than 1% of the time.

[28] This is an evaluation of a program implemented in Washington State. Therefore, we conducted a benefit-cost analysis using this single evaluation.
[29] WSIPP (2017).

[30] Ibid.

2) Interventions for Older Adults with Dementia and/or Their Caregivers

Dementia is a group of symptoms that interfere with everyday activities.[31] It is characterized by a marked decline in memory, language, executive function, social cognition, and a number of other symptoms.[32] Nearly 70% of dementia cases are due to Alzheimer's disease (AD).[33] In 2015, an estimated 106,644 adults over age 65 were living with AD in Washington State.[34] In this report, we use "dementia" to describe AD and other types of dementia inclusively.

Individuals with dementia often rely on informal caregiving. Informal caregivers are typically family members or friends, and they may assist a loved one in activities of daily living[35] and/or by providing emotional support. The behavioral and mood disturbances that characterize dementia can place intense demands on informal caregivers, who are at an increased risk for depressive disorders.[36] There were 335,000 informal dementia caregivers in Washington State in 2016.[37]

We examined three interventions for older adults with dementia and/or their caregivers:

1) Collaborative primary care for dementia,
2) Case management for caregivers of older adults with dementia, and
3) Case management with monetary assistance for caregivers of older adults with dementia.

We reviewed the research evidence on these interventions and their effects on outcomes for older adults with dementia and their informal caregivers. Outcomes for older adults with dementia include:

- Health care costs,
- Hospitalization,
- Mortality, and
- Cognitive functioning.[38]

Outcomes for informal caregivers include:

- Caregiver burden[39] and
- Depression.

[31] Alzheimer's Association. (2018). *What is dementia?*
[32] American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (DSM-5®)*. American Psychiatric Pub.
[33] Vascular or post-stroke dementia accounts for approximately 20% of dementia cases. The remainder is attributed to a variety of dementias, such as Parkinson's dementia, frontal lobe dementia, or Lewy body dementia. Dr. Robert Bree Collaborative. (2017). *Alzheimer's disease and other dementias report and recommendations.*
[34] Washington State Department of Social and Health Services (2016). *Projections of Alzheimer's Dementia in Washington State*.
[35] Activities of daily living (ADLs) are routine activities of self-care that adults can typically perform without assistance. ADLs may include bathing, dressing, personal hygiene, toilet hygiene, and feeding oneself.
[36] Cuijpers, P. (2005). Depressive disorders in caregivers of dementia patients: a systematic review. *Aging & Mental Health, 9*(4), 325-330.
[37] Alzheimer's Association. (2017). 2017 Alzheimer's disease facts and figures.
[38] Cognitive functioning reflects the cognitive mental status (i.e., orientation to time and place, registration of words/objects, or the ability to recall object and language) of the older adult with dementia.
[39] Caregiver burden reflects the stress perceived by informal caregivers of older adults with dementia due to the home care situation.

Although our benefit-cost model can estimate the monetary value of depression for informal caregivers, we are currently unable to monetize caregiver burden for informal caregivers. We are also unable to monetize health care costs, hospitalization, mortality, and cognitive functioning among older adults with dementia at this time. Because we are unable to create a complete picture of the monetary consequences of the captured outcomes, we did not conduct benefit-cost analyses for this group of interventions.

Exhibit 5 provides our meta-analytic results for these interventions. Following the exhibit, we provide short descriptions of the interventions reviewed and our findings.

Exhibit 5

Meta-Analytic Results:
Interventions for Older Adults with Dementia and/or Their Caregivers

Intervention	Outcome	Avg. age	# of effect sizes	# in treatment	Effect size	SE	p-value
Collaborative primary care for dementia (older adult population)	Patient health care costs*	79	1	202	0.053	0.360	0.882
	Patient hospitalization	79	1	170	-0.152	0.202	0.452
	Patient death	79	1	84	-0.028	0.223	0.901
	Patient cognitive functioning	79	1	84	-0.029	0.168	0.864
Case management for caregivers of older adults with dementia	Caregiver depression	61	3	120	-0.215	0.320	0.502
	Caregiver burden	61	3	120	-0.031	0.160	0.845
	Patient cognitive functioning	68	2	90	0.012	0.150	0.936
Case management with monetary assistance for caregivers of older adults with dementia	Caregiver depression	63	1	1,705	-0.049	0.035	0.162
	Caregiver burden	63	1	1,705	-0.036	0.035	0.302

Notes:
"Patient" outcomes are measured outcomes for the older adult with dementia. "Caregiver" outcomes are measured outcomes for the informal caregiver of the older adult with dementia. These results are current as of April 2018. More recent results may be available on WSIPP's website.
* The effect size for this outcome indicates percentage change, not a standardized mean difference effect size.

Collaborative primary care for dementia

Collaborative primary care models[40] for older adults with dementia integrate primary care with specialist and community services with the goal of increasing efficiency in the health care system. A multidisciplinary team that includes at least a care manager and primary care physician—but may integrate other specialists or community providers—conducts an initial assessment and administers an individualized, measurement-based treatment plan.

We found two rigorous evaluations of collaborative primary care for older adults with dementia. The two interventions included in this analysis ranged from 12 to 18 months in duration. Care managers were nurse practitioners or social workers and coordinated with the patient's primary care provider or a larger team of specialists. One study limited its population to patients with possible or probable Alzheimer's disease (AD), while the other study included patients both with AD or other dementias.

We find no evidence of an effect of collaborative primary care on mortality, hospitalization, depression, cognitive functioning, or health care costs for older adults with dementia.

[40] In May 2017, WSIPP published benefit-cost findings on collaborative primary care for behavioral health among older adults, including collaborative primary care for older adults with depression and for older adults with depression and other chronic illnesses. Results for these topics can be found on our website and are described in a previous report: Westley, E., Cramer, J., Bauer, J., Lee, S., Hirsch, M., Burley, M., & Kay, N. (2017). *Interventions to promote health and increase health care efficiency: May 2017 update* (Doc. No. 17-05-3401). Olympia: Washington State Institute for Public Policy.

Case management for caregivers of older adults with dementia

Case management for caregivers targets the informal caregivers of older adults with dementia. These informal caregivers are typically the spouse or the adult child of the older adult with dementia.

Case management typically involves a standardized assessment, an individualized measurement-based treatment plan, and ongoing monitoring and reassessment of the plan.[41] The assessments are used by case managers to identify the needs of the specific caregiver (client), and to develop an individualized treatment plan to address those recognized needs. This treatment plan may include referrals to support groups, respite care, housekeeping, or other supportive services. Case managers reassess clients periodically in order to refine the treatment plan, as needs may change over time. Additionally, case managers may provide education or teach coping strategies directly to their clients.[42]

Case management only. We found five rigorous evaluations of case management for informal caregivers of older adults with dementia.[43] Case managers in the included studies were psychiatrists, home health aides, counselors, registered nurses, and social workers. On average, interventions in this analysis provided monthly case management sessions over a period of 12 months.

On average, we find no evidence that case management for caregivers of older adults with dementia has an effect on caregiver depression, caregiver burden, or on the patient's cognitive functioning.

Case management with monetary assistance. We found a single rigorous evaluation of case management with monetary assistance for caregivers of older adults with dementia.[44] The evaluation is from the Medicare Alzheimer's Disease Demonstration (MADD), a multisite national demonstration project that provided case management and additional monetary assistance for the informal caregivers of older adults with AD or severe dementia. Monetary assistance consisted of capped monthly reimbursement for services referred to caregivers by their case manager (e.g., adult day care, skilled nursing or rehabilitative therapies, respite care, housekeeping). Case managers were social workers or nurses. The intervention lasted 36 months. Monetary assistance averaged $495 per client per month.

In this single study, we find no evidence of an effect on caregiver burden or caregiver depression.

[41] Case management is typically provided in one-on-one sessions in the home of the caregiver.

[42] The education component typically consists of information concerning the progression and expectations of dementia as it pertains to the activities of daily living of both the patient and the caregiver.

[43] Caregivers in the comparison groups received the standardized assessment and usual referrals to other services without case management.

[44] Caregivers in the comparison groups received the standardized assessment and referrals to other services without case management or additional monetary assistance.

Appendices

Interventions to Promote Health and Increase Health Care Efficiency: *April 2018 Update*

I. Topic Examined but Meta-Analysis Not Supported by Literature

Adult Day Services for Older Adults with Dementia

There was not sufficient research literature to conduct a meta-analysis on adult day services (ADS) for older adults with dementia. ADS provides daytime therapeutic activities to older adults with dementia while simultaneously providing respite to informal caregivers.[45] By freeing up caregivers to work or meet other obligations or needs, ADS aims to keep adults with dementia at home for longer, as an alternative to long-term care institutions.[46]

We searched for studies analyzing the effect of ADS for older adults with dementia living in the community on the following outcomes: cognitive functioning (participant and/or caregiver), depression (participant and/or caregiver), nursing home placement, hospital admissions, emergency department admissions, and medical costs. We identified 19 potential studies for inclusion but were unable to include them for various reasons. Many studies did not report results of target outcomes or did not use validated scales to measure outcomes. The remaining studies had methodological or research design problems, such as high attrition, a lack of sufficient controls for baseline characteristics, or a lack of a comparison group.

[45] Robert Wood Johnson Foundation. (2009). *Partners in caregiving: The dementia services program*.
[46] Femia, E.E., Zarit, S.H., Stephens, M.A.P., & Greene, R. (2007). Impact of adult day services on behavioral and psychological symptoms of dementia. *The Gerontologist, 47*(6), 775-788.

II. Studies used in the Meta-Analyses

Group exercise classes (general population)

Cerny, K., Blanks, R., Mohamed, O., Schwab, D., Robinson, B., Russo, A., & Zizz, C. (1998). The effect of a multidimensional exercise program on strength, range of motion, balance and gait in the well elderly. *Gait & Posture, 7*(2), 185-186.

Fitzharris, M.P., Day, L., Fildes, B., Lord, S.R., & Gordon, I. (2010). The Whitehorse NoFalls trial: Effects on fall rates and injurious fall rates. *Age and Ageing, 39*(6), 728-733.

Freiberger, E., Menz, H.B., Abu-Omar, K., & Rütten, A. (2007). Preventing falls in physically active community-dwelling older people: A comparison of two intervention techniques. *Gerontology, 53*(5), 298-305.

Woo, J., Hong, A., Lau, E., & Lynn, H. (2007). A randomised controlled trial of Tai Chi and resistance exercise on bone health, muscle strength and balance in community-living elderly people. *Age and Ageing, 36*(3), 262-268.

Group exercise classes for osteoporosis/osteopenia

Carter, N.D., Khan, K.M., McKay, H.A., Petit, M.A., Waterman, C., Heinonen, A., . . . Flicker, L. (2002). Community-based exercise program reduces risk factors for falls in 65-to 75-year-old women with osteoporosis: Randomized controlled trial. *Canadian Medical Association Journal, 167*(9), 997-1004.

Korpelainen, R., Keinänen-Kiukaanniemi, S., Heikkinen, J., Väänänen, K., & Korpelainen, J. (2006). Effect of impact exercise on bone mineral density in elderly women with low BMD: a population-based randomized controlled 30-month intervention. *Osteoporosis International, 17*(1), 109-118.

Madureira, M.M., Takayama, L., Gallinaro, A.L., Caparbo, V.F., Costa, R.A., & Pereira, R.M.R. (2007). Balance training program is highly effective in improving functional status and reducing the risk of falls in elderly women with osteoporosis: A randomized controlled trial. *Osteoporosis International, 18*, 419-425.

Group exercise classes (high-risk population)

Ng, T.P., Feng, L., Nyunt, M.S., Feng, L., Niti, M., Tan, B.Y., . . . Yap, K.B. (2015). Nutritional, physical, cognitive, and combination interventions and frailty reversal among older adults: A randomized controlled trial. *The American Journal of Medicine, 128*(11), 1225-1236.

Rubenstein, L.Z., Josephson, K.R., Trueblood, P.R., Loy, S., Harker, J.O., Pietruszka, F.M., & Robbins, A.S. (2000). Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 55*(6), 317-21.

Trombetti, A., Hars, M., Herrmann, F.R., Kressig, R.W., Ferrari, S., & Rizzoli, R. (2011). Effect of music-based multitask training on gait, balance, and fall risk in elderly people. *Archives of Internal Medicine, 171*(6), 525-533.

Uusi-Rasi, K., Patil, R., Karinkanta, S., Kannus, P., Tokola, K., Lamberg-Allardt, C., & Sievänen, H. (2015). Exercise and vitamin D in fall prevention among older women: a randomized clinical trial. *JAMA internal medicine, 175*(5), 703-711.

Individual exercise programs (general population)

Gschwind, Y.J., Eichberg, S., Ejupi, A., de Rosario, H., Kroll, M., Marston, H.R., . . . Delbaere, K., (2015). ICT-based system to predict and prevent falls (iStoppFalls): results from an international multicenter randomized controlled trial. *European review of aging and physical activity, 12*(1), 10.

Voukelatos, A., Merom, D., Sherrington, C., Rissel, C., Cumming, R.G., & Lord, S.R. (2015). The impact of a home-based walking programme on falls in older people: The Easy Steps randomised controlled trial. *Age and ageing, 44*(3), 377-383.

Individual exercise classes for osteoporosis/osteopenia

Mikó, I., Szerb, I., Szerb, A., & Poor, G. (2017). Effectiveness of balance training programme in reducing the frequency of falling in established osteoporotic women: A randomized controlled trial. *Clinical rehabilitation, 31*(2), 217-224.

Individual exercise programs (high-risk population)

Boongird, C., Keesukphan, P., Phiphadthakusolkul, S., Rattanasiri, S., & Thakkinstian, A. (2017). Effects of a simple home-based exercise program on fall prevention in older adults: A 12-month primary care setting, randomized controlled trial. *Geriatrics & Gerontology International, 17,* 2157-2163.

Duque, G., Boersma, D., Loza-Diaz, G., Hassan, S., Suarez, H., Geisinger, D., . . . Demontiero, O. (2013). Effects of balance training using a virtual-reality system in older fallers. *Clinical Interventions in Aging, 8*, 257.

Latham, N.K., Anderson, C.S., Lee, A., Bennett, D.A., Moseley, A., & Cameron, I.D. (2003). A randomized, controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Intervention Trial in Elderly Subjects (FITNESS). *Journal of the American Geriatrics Society, 51*(3), 291–299.

Luukinen, H., Lehtola, S., Jokelainen, J., Väänänen-Sainio, R., Lotvonen, S., & Koistinen, P. (2007). Pragmatic exercise-oriented prevention of falls among the elderly: a population-based, randomized, controlled trial. *Preventive medicine, 44*(3), 265-271.

Vogler, C.M., Sherrington, C., Ogle, S.J., & Lord, S.R. (2009). Reducing risk of falling in older people discharged from hospital: a randomized controlled trial comparing seated exercises, weight-bearing exercises, and social visits. *Archives of Physical Medicine and Rehabilitation, 90*(8), 1317-1324.

Tai Chi (general population)

Wolf, S.L., Barnhart, H.X., Kutner, N.G., McNeely, E., Coogler, C., & Xu, T. (1996). Reducing frailty and falls in older persons: An investigation of Tai Chi and computerized balance training. *Journal of the American Geriatrics Society, 44*(5), 489.

Woo, J., Hong, A., Lau, E., & Lynn, H. (2007). A randomised controlled trial of Tai Chi and resistance exercise on bone health, muscle strength and balance in community-living elderly people. *Age and Ageing, 36*(3), 262-268.

Tai Chi (high-risk population)

Logghe, I.H., Zeeuwe, P.E., Verhagen, A.P., Wijnen-Sponselee, R.M., Willemsen, S.P., Bierma-Zeinstra, S.M., . . . Koes, B.W. (2009). Lack of effect of Tai Chi Chuan in preventing falls in elderly people living at home: a randomized clinical trial. *Journal of the American Geriatrics Society, 57*(1), 70-75.

Wolf, S.L., Sattin, R.W., Kutner, M., O'Grady, M., Greenspan, A.I., & Gregor, R.J. (2003). Intense tai chi exercise training and fall occurrences in older, transitionally frail adults: a randomized, controlled trial. *Journal of the American Geriatrics Society, 51*(12), 1693-1701.

Otago Exercise Program (general population)

Campbell, A.J., Robertson, M.C., Gardner, M.M., Norton, R.N., Tilyard, M.W., & Buchner, D.M. (1997). Randomised controlled trial of a general practice programme of home based exercise to prevent falls in elderly women. *BMJ: British Medical Journal, 315(*7115), 1065-1069.

Robertson, M.C., Devlin, N., Gardner, M.M., & Campbell, A.J. (2001). Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 1: Randomised controlled trial. *BMJ: British Medical Journal, 322*(7288), 697.

Otago Exercise Program (high-risk population)

Campbell, A.J., Robertson, M.C., La Grow, S.J., Kerse, N.M., Sanderson, G.F., Jacobs, R.J., . . . Hale, L.A. (2005). Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: the VIP trial. *BMJ: British Medical Journal, 331*(7520), 817.

Home hazard reduction (general population)

Fitzharris, M.P., Day, L., Fildes, B., Lord, S.R., & Gordon, I. (2010). The Whitehorse NoFalls trial: Effects on fall rates and injurious fall rates. *Age and Ageing, 39*(6), 728-733.

Stevens, M., Holman, C.D.A.J., Bennett, N., & de Klerk, N. (2001). Preventing falls in older people: Outcome evaluation of a randomized controlled trial. *Journal of the American Geriatrics Society, 49*(11), 1448-1455.

Home hazard reduction (high-risk population)

Campbell, A.J., Robertson, M.C., La Grow, S.J., Kerse, N.M., Sanderson, G.F., Jacobs, R.J., . . . Hale, L.A. (2005). Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: the VIP trial. *BMJ: British Medical Journal, 331*(7520), 817.

Cumming, R.G., Thomas, M., Szonyi, G., Salkeld, G., O'Neill, E., Westbury, C., & Frampton, G. (1999). Home visits by an occupational therapist for assessment and modification of environmental hazards: A randomized trial of falls prevention. *Journal of the American Geriatrics Society, 47*(12), 1397-1402.

Nikolaus, T., & Bach, M. (2003). Preventing falls in community-dwelling frail older people using a home intervention team (HIT): Results from the randomized Falls-HIT Trial. *Journal of the American Geriatrics Society, 51*(3), 300-305.

Pardessus, V., Puisieux, F., Di Pompeo, C., Gaudefroy, C., Thevenon, A., & Dewailly, P. (2002). Benefits of home visits for falls and autonomy in the elderly: a randomized trial study. *American Journal of Physical Medicine & Rehabilitation, 81*(4), 247-252.

Cognitive behavioral interventions (general population)

Dorresteijn, T.A., Zijlstra, G.R., Ambergen, A.W., Delbaere, K., Vlaeyen, J.W., & Kempen, G.I. (2016). Effectiveness of a home-based cognitive behavioral program to manage concerns about falls in community-dwelling, frail older people: results of a randomized controlled trial. *BMC Geriatrics*, *16*(1), 2.

Zijlstra, G.A.R., Van, H.J.C.M., Ambergen, T., Van, R.E., Van, E.J.T.M., Tennstedt, S.L., & Kempen, G.I.J.M. (2009). Effects of a multicomponent cognitive behavioral group intervention on fear of falling and activity avoidance in community-dwelling older adults: Results of a randomized controlled trial. *Journal of the American Geriatrics Society, 57*(11), 2020-2028.

Multicomponent intervention: exercise and home hazard reduction (general population)

Fitzharris, M.P., Day, L., Fildes, B., Lord, S.R., & Gordon, I. (2010). The Whitehorse NoFalls trial: Effects on fall rates and injurious fall rates. *Age and Ageing, 39*(6), 728-733.

Multicomponent intervention: exercise and home hazard reduction (high risk population)

Campbell, A.J., Robertson, M.C., La Grow, S.J., Kerse, N.M., Sanderson, G.F., Jacobs, R.J., . . . Hale, L.A. (2005). Randomised controlled trial of prevention of falls in people aged ≥75 with severe visual impairment: the VIP trial. *BMJ: British Medical Journal, 331*(7520), 817.

Multicomponent interventions including group exercise and vitamin D supplementation (high-risk population)

Uusi-Rasi, K., Patil, R., Karinkanta, S., Kannus, P., Tokola, K., Lamberg-Allardt, C., & Sievänen, H. (2015). Exercise and vitamin D in fall prevention among older women: a randomized clinical trial. *JAMA Internal Medicine, 175*(5), 703-711.

Multifactorial programs: physician-led (high-risk population)

Conroy, S., Kendrick, D., Harwood, R., Gladman, J., Coupland, C., Sach, T., . . . Masud, T. (2010). A multicentre randomised controlled trial of day hospital-based falls prevention programme for a screened population of community-dwelling older people at high risk of falls. *Age and Ageing, 39*(6), 704-710.

Davison, J., Bond, J., Dawson, P., Steen, I.N., & Kenny, R.A. (2005). Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention—a randomised controlled trial. *Age and Ageing, 34*(2), 162-8.

Spice, C.L., Morotti, W., George, S., Dent, T.H., Rose, J., Harris, S., & Gordon, C.J. (2009). The Winchester Falls Project: A randomised controlled trial of secondary prevention of falls in older people. *Age and Ageing, 38*(1), 33-40.

Multifactorial interventions: nurse-led (general population)

Shumway-Cook, A., Silver, I.F., LeMier, M., York, S., Cummings, P., & Koepsell, T.D. (2007). Effectiveness of community-based multifactorial intervention on falls and fall risk factors in community-living older adults: A randomized, controlled trial. *The Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 62*(12), 1420–1427.

Multifactorial interventions: nurse-led (high-risk population)

Olsson Möller, O., Kristensson, J., Midlöv, P., Ekdahl, C., & Jakobsson, U. (2014). Effects of a one-year home-based case management intervention on falls in older people: a randomized controlled trial. *Journal of aging and physical activity, 22*(4), 457-464.

Spice, C.L., Morotti, W., George, S., Dent, T.H., Rose, J., Harris, S., & Gordon, C.J. (2009). The Winchester falls project: A randomised controlled trial of secondary prevention of falls in older people. *Age and Ageing, 38*(1), 33-40.

van Rijn, M. (2017). *Nurse-led multifactorial care in community-dwelling older people: Outcomes on daily functioning, experiences and costs.* (Doctoral thesis, University of Amsterdam).

Collaborative primary care for dementia (older adult population)

Callahan, C.M., Boustani, M.A., Unverzagt, F.W., Austrom, M.G., Damush, T.M., Perkins, A.J., . . . Hendrie, H.C. (2006). Effectiveness of collaborative care for older adults with Alzheimer Disease in primary care: A randomized controlled trial. *JAMA: The Journal of the American Medical Association, 295*(18), 2148-2157.

Duru, O.K., Ettner, S.L., Vassar, S.D., Chodosh, J., & Vickrey, B.G. (2009). Cost evaluation of a coordinated care management intervention for dementia. *American Journal of Managed Care, 15*(8), 521-528.

Case management for caregivers of older adults with dementia

Chien, W.T., & Lee, I.Y.M. (2008). A disease management program for families of persons in Hong Kong with dementia. *Psychiatric Services, 59*(4), 433-436.

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