Cost-Effectiveness of a Statewide Falls Prevention Program in Pennsylvania: Healthy Steps for Older Adults

Steven M. Albert, PhD; Jonathan Raviotta, MPH; Chyongchiou J. Lin, PhD; Offer Edelstein, PhD; and Kenneth J. Smith, MD

ABSTRACT

OBJECTIVES: Pennsylvania's Department of Aging has offered a falls prevention program, "Healthy Steps for Older Adults" (HSOA), since 2005, with about 40,000 older adults screened for falls risk. In 2010 to 2011, older adults 50 years or older who completed HSOA (n = 814) had an 18% reduction in falls incidence compared with a comparison group that attended the same senior centers (n = 1019). We examined the effect of HSOA on hospitalization and emergency department (ED) treatment, and estimated the potential cost savings.

STUDY DESIGN: Decision-tree analysis.

METHODS: The following were included in a decision-tree model based on a prior longitudinal cohort study: costs of the intervention, number of falls, frequency and costs of ED visits and hospitalizations, and self-reported quality of life of individuals in each outcome condition. A Monte Carlo probabilistic sensitivity analysis assigned appropriate distributions to all input parameters and evaluated model results over 500 iterations. The model included all ED and hospitalization episodes rather than just episodes linked to falls.

RESULTS: Over 12 months of follow-up, 11.3% of the HSOA arm and 14.8% of the comparison group experienced 1 or more hospitalizations ($P = .04$). HSOA participants had less hospital care when matched for falls status. Observed values suggest expected costs per participant of $3013 in the HSOA arm and $3853 in the comparison condition, an average savings of $840 per person. Results were confirmed in Monte Carlo simulations ($3164 vs $3882, savings of $718).

CONCLUSIONS: The savings of $718 to $840 per person is comparable to reports from other falls prevention economic evaluations. The advantages of HSOA include its statewide reach and integration with county aging services.

Am J Manag Care. 2016;22(10):638-644

The public health significance of falls among adults 50 years or older is clear. In 2011, the rate of nonfatal fall-related injuries requiring emergency department (ED) care was 2301 per 100,000 among individuals aged 50 to 54; however, it was 14,159 per 100,000 among individuals 85 years or older.[1] Self-report measures from health surveys confirm the high risk of falls (30%-40% annually in individuals 65 years or older), and it only increases with age (40%-50% of older adults age 80 or older). Even noninjurious falls are disabling in that they are associated with activity restriction, isolation, deconditioning, and depression. In 2010, medical care costs associated with nonfatal falls in the United States for individuals 50 years or older totaled about $40 billion.[1]

Pennsylvania's Department of Aging has offered a falls prevention program in its network of senior centers and related sites since 2007, with about 40,000 older adults completing the program to date. "Healthy Steps for Older Adults" (HSOA) offers screening for falls risk and education regarding falls prevention using this statewide aging services infrastructure. Senior centers and allied sites host the program, and older adults interested in the program may complete it as part of their normal attendance at senior center events or specifically because of an interest in falls prevention. This program is voluntary and available to all adults residing in the state 50 years or older.

HSOA includes the following elements: physical performance assessments of balance and mobility conducted by staff or trained volunteers (Timed Get Up and Go, 1-legged stand, 60-second chair stand), referrals for physician care and home safety for participants scoring below age- and gender-based norms on performance assessments, and a 2-hour falls prevention class involving recognition of home hazards and falls risk situations, as well as demonstrations of exercises designed to improve balance and mobility. The PrimeTime Health office of the PA Department of Aging assures program fidelity by training staff at sites, monitoring data entry, conducting brief follow-up interviews with a random 10% sample of participants after programs, and hosting monthly conference calls with the county Area Agencies on Aging. HSOA recently re-

ceived certification as an evidence-based falls prevention program by the federal Administration for Community Living.

Quasi-experimental evidence for the effectiveness of this short-term, low-cost, populationwide program is now available and suggests that the program reduced falls incidence by 18% over a median of 7.5 months of follow-up.[2] Details of the evaluation study design and use of monthly interactive voice response (IVR) calls to assess falls have been reported.[3,4]

TAKE-AWAY POINTS

Since 2005, Pennsylvania's Department of Aging has offered a falls prevention program, "Healthy Steps for Older Adults" with about 40,000 older adults screened for falls risk. In an evaluation, the program was associated with an 18% reduction in falls incidence. The cost-effectiveness of the program is evident in:

- Over 12 months of follow-up, 11.3% of individuals in the program experienced 1 or more hospitalizations versus 14.8% in a matched comparison group.
- Program participants had less hospital care when matched for falls status.
- Expected costs of hospital and emergency department care averaged $3013 per participant in the program arm and $3853 in the comparison condition—a savings of $840.

Briefly, from 2010 to 2011, older adults who completed participation in HSOA (n = 814), or who did not but attended the same senior center sites (n = 1019), were enrolled and followed monthly for up to 12 months. Falls were defined as any occasion when an individual ended up on the floor or ground without being able to stop or prevent it. Although participants were not randomly allocated to study conditions, the 2 groups did not differ in demography, self-reported health status, falls risk at baseline, or attrition over follow-up. We ascertained falls each month using a telephone IVR system. In multivariate models, adjusted falls incidence rate ratios among HSOA participants were lower than in the comparator group for both total (incidence rate ratio [IRR], 0.83; 95% CI, 0.72-0.96) and activity-adjusted (IRR, 0.81; 95% CI, 0.70-0.93) months of follow-up.[2]

In prior research, we also examined process indicators to assess the uptake of the program.[2,3] Of HSOA participants, 84.1% reported they were told how well they did on the mobility and balance screening. Among participants who were told by staff that they were at a high risk of falling (21.3%), 21.5% reported they saw a physician to discuss their HSOA assessment. Most HSOA participants (92.1%) at a high risk of falling reported they were given a home safety guide; 78.6% reported use of the guide to conduct a home safety assessment, and 32% reported a change in the home environment as a result of this effort.

Although the falls reduction benefit is important in its own right, it would also be valuable to see if HSOA lowers healthcare utilization by keeping individuals out of the ED and hospital. This benefit might accrue if having fewer falls results in less of a need for healthcare services, or if the program lowers the risk of high-intensity healthcare utilization among those who do fall. Because our monthly follow-up telephone contact also collected information from participants about use of the ED and hospitalization, we were able to examine the cost-effectiveness of the program for these outcomes.

For this analysis, we used all ED and hospitalization episodes, rather than just episodes linked to falls. We chose this approach because monthly calls did not establish whether use of medical care was definitively the result of a fall, nor did we have access to diagnostic information about the reason for treatment or procedures performed. We used the more conservative approach of examining all ED and hospital events by falls status and intervention arm.

Although many cost analyses are available, these largely involve hospital,[5] nursing home,[6,7] or emergency medical service[8] samples. Community-based assessments are less common, and these have mostly been limited to evaluations of clinical interventions,[9,10] rather than the broad-based community-level intervention assessed in our study.

The goal of this study was to determine cost savings associated with the HSOA falls prevention program. We examined the frequency of falls and episodes of ED, as well as hospital, use in the intervention and comparison arms. We also elicited health utilities for respondents in groups defined by falling and medical use categories and used these quality-of-life (QoL) utility values to examine the incremental cost-effectiveness ratio (ICER) of the program.

METHODS

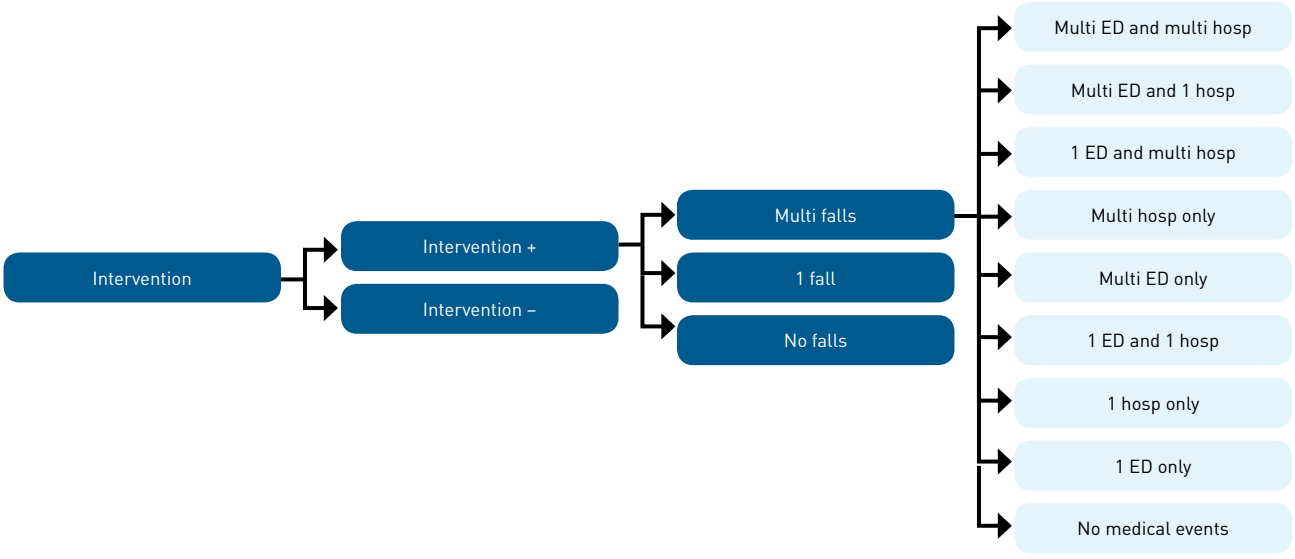
We examined outcomes associated with implementing HSOA. To determine the cost-effectiveness of the intervention, observations from the statewide evaluation were used to construct a decision tree using TreeAge Pro 2015 (TreeAge Software, Inc, Williamstown, Massachusetts). The model inputs were the per-person costs of the intervention, the number of falls, the frequency and costs of ED visits and in-patient hospitalizations, and self-reported QoL of individuals in each outcome condition of the decision tree. All participants completed signed informed consent, and the Institutional Review Board of the University of Pittsburgh approved the research protocol.

Ascertainment of Outcome States

Falls and medical care utilization, as mentioned earlier, were assessed with monthly telephone calls using IVR technology. Respondents were registered into an Internet-based system and were automatically dialed every 30 days to complete a 6-question report on falls, physical activity, hospitalization, and ED use over the prior month. A recording posed questions, which respondents answered by pressing buttons on the telephone; for example, the instructions were "press 1 for yes, 2 for no." Although one-third of the sample switched from IVR to in-person calls over follow-up, the proportion switching did not differ between study arms.[4]

IVR reports of falls over the follow-up period were significantly correlated with both self-reported and performance assessment

FIGURE 1. Simplified Tree: Model of Treatment Conditions by Number of Falls and Intervention Exposure



ED indicates emergency department; hosp, hospitalization; intervention +, took part in the intervention; intervention –, did not take part in the intervention; multi, multiple.

of balance.[2] We were unable to validate reports of ED and hospital treatment elicited in telephone follow-up, but the absence of differences across study arms in baseline characteristics and in attrition over follow-up reduced the likelihood of differential reporting of healthcare utilization.

To elicit QoL ratings, respondents completed the EuroQol 5-Dimensions Questionnaire (EQ-5D).[11] In the EQ-5D, respondents report level of difficulty with mobility, self-care, usual activities, pain, and mental health. Each of the 5 domains has 3 levels: no problems, some problems, extreme problems. Each combination of problems reported for the 5 domains has a utility value ranging from 0 to 1.0. We used the EQ-5D scoring algorithm described in a US replication study.[12] EQ-5D values were elicited at a 6-month follow-up interview.

Model

The primary outcomes were the expected per-person direct medical costs and individual-level utility of each condition. As mentioned earlier, the HSOA intervention significantly reduced the incidence of number of falls among participants compared with a comparison group.[1] The present model compared the total per-person costs of the intervention, ED visits, and hospitalizations between HSOA participants and nonparticipants; that is, we did not limit outcomes to ED or hospital episodes associated with falls, but rather, we considered all events over the observation period. For this analysis, we extended the 7.5-month follow-up period reported in earlier analyses to 12 months. The model also examined self-reported QoL utility values of individuals within each outcome condition. Interpretation of the model is driven by the assumption that: participation in the intervention will result in fewer falls, ED visits, and hospitalizations; the total costs of these episodes will be lower; and the QoL of HSOA participants in any outcome condition will be higher than that of nonparticipants.

Decision Tree

The decision tree was constructed as a series of binary chance nodes branching from an intervention exposure decision node. Logic for the treatment and comparison groups was identical and included all permutations of falls and treatments ranging from no falls and no treatments to multiple falls, multiple ED visits, and multiple hospitalizations. **Figure 1** is a simplified illustration of the tree for 1 branch. Available data were categorized in the following way: HSOA = yes or no; falls = 0, 1, ≥2; ED visits = 0, 1, ≥2; hospitalizations = 0, 1, ≥2. Branch utilities were calculated by averaging QoL utility values for all individuals within each outcome condition.

Costs for ED and hospital treatment were represented by the mean cost of the medical events in Pennsylvania during the study period based on state averages from the PA Health Care Cost Containment Council: $1100 for each ED treatment and $18,083 for each hospitalization. In the categories of ≥2 ED episodes or ≥2 hospitalizations (or combinations of a single event of the one type plus ≥2 of the other), we averaged costs. Hence, average costs for the category of ≥2 hospitalizations vary, for example, because individuals in the category often had more than 2 hospitalizations (eg, respondents in the ≥2 hospitalization group had 2 to 6 hospitalizations over the

TABLE. Respondent States and Model Parameter Values

	Intervention								
	No Falls			1 Fall			2 Falls		
Description	n = 525	Cost	Utility	n = 180	Cost	Utility	n = 92	Cost	Utility
No ED visits and no hospitalization	430	$0	0.853	121	$0	0.836	57	$0	0.813
1 ED visit	43	$1100	0.844	23	$1100	0.822	9	$1100	0.796
≥2 ED visits	9	$2567	0.827	6	$2200	0.727	12	$2842	0.682
1 hospitalization	29	$18,083	0.856	16	$18,083	0.795	4	$18,083	0.817
1 ED visit and 1 hospitalization	5	$19,183	0.657	4	$19,183	0.942	8	$19,183	0.858
≥2 ED visits and ≥2 hospitalizations	1	$38,366	0.708	0	$38,366[a]	0.708[a]	0	$38,366[a]	0.708[a]
≥2 hospitalizations	8	$42,947	0.829	8	$49,728	0.754	1	$36,166	0.263
1 ED visit and ≥2 hospitalizations	1	$37,266	0.708	0	$37,266[a]	0.75[a]	1	$37,266	0.8
≥2 ED visits and 1 hospitalization	1	$20,283[a]	0.705[a]	2	$20,283	0.705	1	$20,283	0.718
	Comparison								
	No Falls			1 Fall			2 Falls		
Description	n = 638	Cost	Utility	n = 201	Cost	Utility	n = 141	Cost	Utility
No ED visits and no hospitalization	510	$0	0.857	128	$0	0.833	73	$0	0.796
1 ED visit	54	$1100	0.842	30	$1100	0.798	21	$1100	0.81
≥2 ED visits	9	$2322	0.813	5	$2420	0.936	13	$2877	0.81
1 hospitalization	41	$18,083	0.786	20	$18,083	0.832	16	$18,083	0.744
1 ED visit and 1 hospitalization	5	$19,183	0.905	7	$19,183	0.719	8	$19,183	0.745
≥2 ED visits and ≥2 hospitalizations	1	$38,366	0.5	0	$38,366[a]	0.5[a]	1	$38,366	0.778
≥2 hospitalizations	15	$43,399	0.807	10	$41,591	0.76	8	$49,728	0.776
1 ED visit and ≥2 hospitalizations	3	$43,294	0.789	3	$49,321	0.609	0	$49,321[a]	0.609[a]
≥2 ED visits and 1 hospitalization	4	$20,283	0.709	1	$20,283	0.8	2	$20,283	0.689

ED indicates emergency department.
[a]Some permutations of outcomes were not observed in the study population. Missing utility values were populated with the value of the less extreme adjacent condition. Cost and utility estimates are averages computed from the distribution of respondents in the outcome state.

study period). The cost of the HSOA program is $70 per participant, the amount senior center sites are reimbursed for the program.

Because of the many permutations of outcome states, some nodes required estimation of values for missing data. The **Table** reports the number of respondents in each outcome state by intervention status. Missing utility values were populated with the value of the less extreme adjacent condition to reduce risk of bias from potentially spurious treatment effects. All probabilities not explicitly provided by the study results were derived using Bayesian transformations of the available data.

We calculated the ICER from the model inputs and conducted sensitivity analyses to debug and validate model performance. The numerator of the ICER represents change in resources used associated with HSOA. The denominator of ICER represents difference in quality-adjusted life-years (QALYs) resulting from participating in HSOA.

Sensitivity Analyses

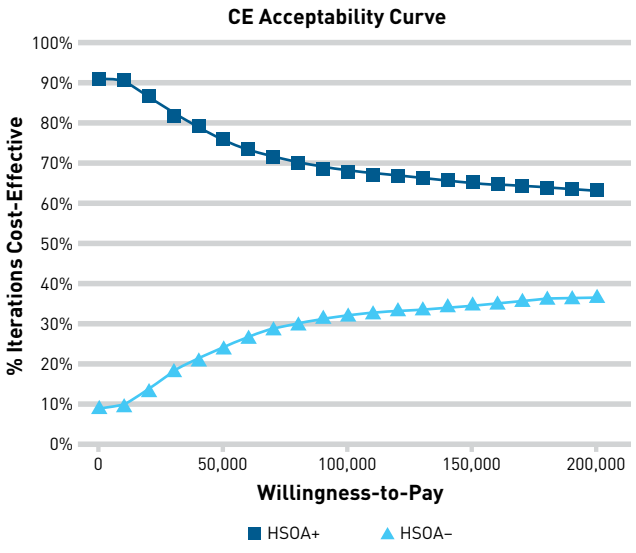
We evaluated the consistency of model predictions across a range of input conditions using 2 methods. First, we individually varied all model parameters across a range of plausible values—50% to 150% of each of the observed medical treatment costs and 0.45 to 0.96 for each of the observed QoL values—to determine which parameters, if any, had the greatest effect on the model results. Second, we conducted a Monte Carlo probabilistic sensitivity analysis, where a suitable probability distribution was assigned to each input parameter.[13] The model was then computed 500 times using random values sampled from each parameter distribution. The results of these iterations were plotted as a cost-effectiveness acceptability curve to visualize the likelihood of acceptability of each strategy at a given cost-per-QALY-gained threshold value.

RESULTS

Features of Study Participants

In the evaluation of HSOA, 797 (97.9%) people in the intervention arm and 980 (96.1%) in the comparison arm had 1 or more months of follow-up. Attrition in the study arms over 12 months was low and

FIGURE 2. Cost-Effectiveness Acceptability Curve for HSOA[a]



HSOA+ indicates participation in Healthy Steps for Older Adults; HSOA–, no participation in HSOA.

[a]Figure indicates the percentage of model iterations from the 500-iteration Monte Carlo probabilistic sensitivity analysis that resulted in each strategy's dominance at a given cost (willingness-to-pay) per quality-adjusted life-year threshold. One-way sensitivity analyses individually swept across 50% to 150% of medical treatment costs and 0.45 to 0.96 of the observed utility values. Monte Carlo probabilistic sensitivity analyses used randomly selected cost values from gamma distributions and utility values from beta distributions.

nondifferential (<10% for withdrawal and <2% for other loss to follow-up). Median follow-up, which involved monthly telephone assessment, was 10 months in both arms. As mentioned earlier, at baseline, the groups did not differ in measures of health or falls risk factors.[2,3]

The mean age and standard deviation (SD) of study participants was 75.5 (8.5); 79.2% were female, 11.1% nonwhite, and 22.8% resided in metro counties with less than 250,000 residents or in nonmetro counties. The mean EQ-5D value at baseline was 0.829 (SD = 0.139). For the particular EQ-5D domains, 38.1% reported problems with mobility, 6% with self-care, 28.1% with usual activities, 60.9% with pain, and 29.5% with anxiety or depressed mood.

Frequency of Falls, Hospitalization, and ED Treatment by Study Arm

As the Table shows, the proportion of individuals falling during the follow-up period was very similar across study groups: 34.2% of HSOA participants reported a fall over the 12 months following the program compared with 34.9% of the comparison group. The proportion reporting at least 2 falls was higher in the comparison arm—14.4% compared with 11.5% in individuals completing HSOA—although not significantly different ($P = .08$). The comparison arm was also more likely to be in the more severe utilization states, such as at least 2 ED or any hospital episodes over the 12 months (17.6% vs 14.7%; $P = .11$). Overall, 11.3% of the HSOA arm and 14.8% of the comparison group experienced 1 or more hospitalizations (irrespective of ED treatment) over follow-up ($P = .04$). Finally, HSOA participants had less hospital care when matched for falls status. For example, in the group reporting at least 2 falls, 16.3% of the HSOA group reported a hospitalization; in the comparison group with at least 2 falls, 24.8% reported hospitalization ($P = .14$).

Modeling Cost-Effectiveness of Healthy Steps for Older Adults

Both the observed values from study data and the Monte Carlo probabilistic sensitivity analysis suggest that HSOA was cost-effective within the assumptions of the model. The expected costs per participant were $3013 in the HSOA arm and $3853 in the comparison condition, an average savings of $840 per person.

As shown in the Table, QoL utilities were lower in individuals reporting more falls and in those who reported a greater number of ED and hospital episodes. However, the overall difference in QoL was small between study arms. The mean was 0.833 in HSOA participants and 0.825 in the comparison group. Although small, including the differential QoL utility values for participants in each outcome condition resulted in program dominance over the comparison arm; that is, the HSOA program was both less costly and resulted in higher QoL ratings for participants.

The Monte Carlo probabilistic sensitivity analysis produced similar results. **Figure 2** shows the percentage of model iterations that resulted in each strategy's favorability at a given cost-per-QALY-threshold value. For values less than or equal to $200,000 per QALY, the intervention strategy was likely to be favored over the nonintervention arm. Additionally, the model suggests that the lower the threshold value, the more likely the intervention will be favored. After 500 iterations, the mean per-person expected cost was $3164 in the intervention arm (SD = $369) compared with $3882 in the comparison arm (SD = $365)—a savings of $718. As was observed in the base case, QoL scores were nearly identical in both arms. The mean scores were 0.822 (SD = 0.013) in the intervention and 0.821 (SD = 0.013) in the comparison group.

In 1-way sensitivity analyses of the base case, in which we varied each parameter individually across a wide range of plausible values, we observed no threshold effects. That is, the intervention was always favored over the comparison, even when sweeping across values both lower and higher than those observed in the study. Of the input parameters, utility values had the greatest impact on the model in sensitivity analyses, with the largest influence attributed to the utility associated with the condition "2 ED visits, no falls" in the intervention branch. To test for model robustness within the narrow QoL range, the Monte Carlo analysis was run a second time holding the utilities reported by participants with no medical events to mean values. Under these conditions, the intervention was more highly favored, suggesting that QoL measurement effects are biased against the intervention.

DISCUSSION

In this quasi-experimental assessment, HSOA was associated with reduced rates of ED treatment and hospitalization, in addition to a reduction in falls. The proportion reporting at least 2 falls was higher in the comparison arm than in individuals completing HSOA (14.4% vs 11.5%), and HSOA participants had less hospital care among individuals with 2 or more falls (16.3% vs 24.8%). The result was lower costs for HSOA participants. The expected costs per participant were $3013 in the HSOA arm and $3853 in the comparison condition. Monte Carlo simulations confirmed the superiority of HSOA ($3164 vs $3882).

On the other hand, patient-reported QoL hardly differed between the HSOA and comparison arms. Still, even though the narrow range of scores biases against the intervention, the intervention ICER showed dominance over the comparison arm. Why differences in health services utilization did not result in larger differences in QoL utilities is unclear. It may be that the measure is not sensitive to short-term ED treatment or hospitalization. Also, as mentioned earlier, we elicited utilities only once at the midpoint of the follow-up period, so the utilities may not adequately reflect the effect of healthcare utilization or differences in falls risk. It is also possible that the relatively small number of respondents in each arm experiencing the healthcare events did not result in large changes in QoL overall in the 2 groups.

A future area of research would be to compare the cost-effectiveness of HSOA to results from more intensive falls prevention programs, which have demonstrated greater treatment effects.[15] Alternatively, it would be valuable to compare the current HSOA program with enhanced HSOA efforts, such as including more intensive follow-up for physician referrals or referrals for eye exams and medication therapy review. In fact, these enhancements are currently being considered for HSOA.

Limitations

Findings from this research should be interpreted in light of study limitations. First, ED treatment and hospitalization were self-reported and our model used average costs. No regional differences were taken into account in costs of medical care. Outpatient care and indirect medical costs were not included. Program costs also included only operational expenses directly associated with the program and did not include overhead associated with senior centers or PA Department of Health administration costs. Moreover, healthcare utilization was not limited to treatment due to falls. As mentioned earlier, we examined all hospitalization and ED treatment. This approach has the virtue of capturing all medical events, but is not specific to falls. Future evaluations of the program should seek ways to validate reports of ED and hospital treatment and analyze fall-related injuries rather than all medical events. If the HSOA and comparison groups are well matched, as they appear to be,[2] differences in costs may be underestimated in our analysis, although the nonrandomized basis of the comparison may mask other selection biases not identified in the research, especially if more motivated, healthier subjects were likely to self-select into the intervention group.

CONCLUSIONS

Based on these results, we conclude that HSOA is cost-effective. Despite the limitations described above, HSOA program costs are low, so that even relatively small reductions in expensive medical events make the program a reasonable investment in population health. On average, the savings of $718 to $840 per person is comparable to reports from other falls prevention economic evaluations. For example, savings reported from other community-based falls intervention programs were $530 in "Tai Chi Moving for Better Balance," $134 for "Stepping On," $938 for "Matter of Balance," and $429 for the "Otago Falls Prevention Program."[14] Advantages of Pennsylvania's HSOA program include its statewide reach and integration with county aging services. The cost effectiveness of HSOA suggests that primary prevention of falls using aging services infrastructure is a reasonable public health investment.

Author Affiliations: Department of Behavioral and Community Health Sciences (SMA, OE), Department of Family Medicine (JR, CJL), and Department of General Medicine (KJS), University of Pittsburgh, Pittsburgh, PA.

Source of Funding: Cooperative Agreement DP002657 from the Centers for Disease Control and Prevention (CDC); University of Pittsburgh Health Promotion and Disease Prevention Research Center, U48 DP001918, CDC.

Author Disclosures: Dr Albert worked with the PA Department of Aging to provide analyses for the ADEPP review of program effectiveness. The remaining authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article. The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the CDC.

Authorship Information: Concept and design (SMA, OE, CJL); acquisition of data (SMA); analysis and interpretation of data (SMA, JR, CJL, KJS); drafting of the manuscript (SMA, OE, JR); critical revision of the manuscript for important intellectual content (SMA, JR, CJL, OE, KJS); statistical analysis (SMA, OE); obtaining funding (SMA); administrative, technical, or logistic support (SMA, OE, KJS); and supervision (SMA).

Address Correspondence to: Steven M. Albert, PhD, Department of Behavioral and Community Health Sciences, Graduate School of Public Health, Parran 208, 130 DeSoto St, Pittsburgh, PA 15261. E-mail: smalbert@pitt.edu.

REFERENCES

1. Data & statistics (WISQARS): cost of injury reports. CDC website. https://www.cdc.gov/injury/wisqars/. Accessed June 29, 2015.

2. Albert SM, King J, Boudreau R, Prasad T, Lin CJ, Newman AB. Primary prevention of falls: effectiveness of a statewide program. *Am J Public Health.* 2014;104(5):e77-e84. doi: 10.2105 /AJPH.2013.301829.

3. Albert SM, Edelstein O, King J, et al. Assessing the quality of a non-randomized pragmatic trial for primary prevention of falls among older adults. *Prev Sci.* 2015;16(1):31-40. doi: 10.1007/s11121-014-0466-2.

4. Albert SM, King J, Keene RM. Assessment of an interactive voice response system for identifying falls in a statewide sample of older adults. *Prev Med.* 2015;71:31-36. doi: 10.1016/j.ypmed.2014.12.006.

5. Haines TP, Hill A-M, Hill KD, et al. Cost effectiveness of patient education for the prevention of falls in hospital: economic evaluation from a randomized controlled trial. *BMC Med.* 2013;11:135. doi: 10.1186/1741-7015-11-135.

6. Heinrich S, Rapp K, Stuhldreher N, Rissmann U, Becker C, König HH. Cost-effectiveness of a multifactorial fall prevention program in nursing homes. *Osteoporosis Int.* 2013;24(4):1215-1223. doi: 10.1007/s00198-012-2075-x.

7. Latimer N, Dixon S, Drahoita AK, Severs M. Cost-utility analysis of a shock-absorbing floor intervention to prevent injuries from falls in hospital wards for older people. *Age Ageing.* 2013;42(5):641-645. doi: 10.1093/ageing/aft076.

8. Sach TH, Logan PA, Coupland CA, et al. Community falls prevention for people who call an emergency ambulance after a fall: an economic evaluation alongside a randomized controlled trial. *Age Ageing.* 2012;41(5):635-641. doi: 10.1093/ageing/afs071.

9. Frick KD, Kung JY, Parrish JM, Narrett MJ. Evaluating the cost-effectiveness of fall prevention programs that reduce fall-related hip fractures in older adults. *J Am Geriatr Soc*. 2010;58(1):136-141. doi: 10.1111/j.1532-5415.2009.02575.x.

10. Irvine L, Conroy SP, Sach T, et al. Cost-effectiveness of a day hospital falls prevention programme for screened community-dwelling older people at high risk of falls. *Age Ageing.* 2010;39(6):710-716. doi: 10.1093/ageing/afq108.

11. Kind P, Dolan P, Gudex C, Williams A. Variations in population health status: results from a United Kingdom national questionnaire survey. *BMJ.* 1998;316(7133):736-741.

12. Shaw JW, Johnson JA, Coons SJ. US valuation of the EQ-5D health states: development and testing of the D1 valuation model. *Med Care.* 2005;43(3):203-220.

13. Briggs AH, Goeree R, Blackhouse G, O'Brien BJ. Probabilistic analysis of cost-effectiveness models: choosing between treatment strategies for gastroesophageal reflux disease. *Med Decis Making* 2002;22(4):290-308.

14. Evidence-based falls prevention programs: saving lives, saving money. National Council on Aging website. https://www.ncoa.org/wp-content/uploads/Falls-Prevention-Programs-Saving-Lives-Saving-Money-NCOA-Infographic.pdf. Published 2015. Accessed December 21, 2015.

15. Carande-Kulis V, Stevens JA, Florence CS, Beattie BL, Arias I. A cost-benefit analysis of three older adult fall prevention interventions. *J Safety Res* 2015;52:65-70. doi: 10.1016/j.jsr.2014.12.007. ■

www.ajmc.com Full text and PDF