Improving the functional fitness of older adults through Lifelong Improvements through Fitness Together (LIFT): Use of an integrated research-practice partnership approach in community and clinical settings

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Academic Abstract

Older adults represent one of the fastest growing populations as well as one of the most inactive. The effects of inactivity (e.g., fall risk, reduced quality of life, inability to age in place) may be mitigated through health promotion programs that include strength-training components. In addition to targeted exercises, it is recommended that programs for older adults incorporate principles of group dynamics (e.g., group goal setting, group distinctiveness) as these types of interventions have previously increased adherence and compliance of physical activity beyond the life of the program and are more effective than individually delivered interventions (e.g., at home DVD, one-on-one). However, these programs are not readily adopted and sustained in practice, which could reflect a lack of programmatic fit within the intended delivery setting. Forming a partnership with key stakeholders within the intended practice setting (e.g., communities and clinics) to identify or develop an evidence-based program that satisfies the mission, values, and resources of the deliver setting, may influence program uptake and sustainability. It is essential to assess setting- and staff-level perceptions of program 'fit' prior to successful implementation. Once interventions are embedded within the standards of care or practice, the intervention has the potential to reach a greater number of older adults and improve their functional fitness outcomes. These intervention attributes are outlined in the prominent RE-AIM Framework: Reach, Effectiveness, Adoption, Implementation, and Maintenance. Taken together, practice- and research- adaptations may increase the adoption of an intervention, and it is necessary to also measure the degree to which an adapted program impacts Reach, Effect, Implementation, and Maintenance. Practice- and evidence-based adaptations are often necessary and inevitable to improve intervention fit within an intended delivery setting. The overall objective of this dissertation was to use an integrated research-practice partnership approach to select, adapt, and evaluate effects of a multi-faceted strength-training program for older adults in community and clinical settings. The aim of Manuscript 1 was to describe the process by which an evidence-based intervention was adapted to meet the needs of a community entity as well as the initial Adoption, Implementation, and Maintenance dimensions of the RE-AIM framework. Manuscript 2 aims to evaluate the initial Reach of older adults and Effect on functional fitness of the adapted program, LIFT, to generate evidence in support of the adapted intervention through an integrated research-practice partnership with a community entity. Manuscript 3 outlines the development, processes, and temporal outcomes of an integrated research-practice partnership approach aimed at linking stakeholders across the academic-clinical-community continuum to assess feasibility, acceptability, and appropriateness outcomes associated with Implementation of a LIFT referral scheme. Based on the research presented in this dissertation, it is concluded that an integrated research-practice partnership, although time intensive, may be an effective approach to report real-world adaptations based on the needs of the delivery setting without compromising effects of an evidence-based strength-training intervention for older adults.

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General Audience Abstract

Older adults represent one of the fastest growing populations as well as one of the most inactive. The effects of inactivity (e.g., fall risk, reduced quality of life, inability to age in place) may be mitigated through health promotion programs that include strength-training components. In addition to targeted exercises, it is recommended that programs for older adults incorporate principles of group dynamics (e.g., group goal setting, group distinctiveness) as these types of interventions have previously increased adherence and compliance of physical activity beyond the life of the program and are more effective than individually delivered interventions (e.g., at home DVD, one-on-one). However, these programs are not readily integrated into standard practice, which could reflect a lack of programmatic fit within the intended delivery setting. Forming a partnership with key stakeholders of the intended practice setting (e.g., communities and clinics) may influence program adoption and sustainability. It is essential to assess delivery personnel perceptions of intervention 'fit' at the forefront of implementation. Once interventions are embedded within the standards of care or practice, the intervention has the potential to improve outcomes such as reaching a greater number of older adults and improving their functional fitness, or the ability to complete activities of daily living with ease. Taken together, adaptations may increase the uptake of an intervention, and it is necessary to also measure the degree to which an adapted program impacts the reach of the target population, effectiveness, consistency of delivery in the intended delivery setting, and sustainability. The overall objective of this dissertation was to use an integrated research-practice partnership approach to select, adapt, and evaluate effects of a multi-faceted strength-training program for older adults in community and clinical settings. The aim of Manuscript 1 was to describe the process by which an evidence-based intervention was adapted to meet the needs of a community entity as well as the initial uptake, delivery, and sustainability. Manuscript 2 evaluates the initial reach of older adult participants in a community-based setting and the effect on functional fitness of the adapted program through an integrated research-practice partnership. Manuscript 3 outlines the development, processes, and temporal outcomes of an integrated research-practice partnership aimed at linking stakeholders across the academic-clinical-community continuum to assess perceptions of intervention 'fit' within a clinical setting. Based on the research presented in this dissertation, it is concluded that an integrated research-practice partnership, although time intensive, may be an effective approach to report real-world adaptations of an evidence-based intervention based on the needs of the delivery personnel without compromising effects on improving the functional fitness of older adults.

Dedication

This work is dedicated to Kevin, Skylar, Bentley, Bo, Binx, and Calvin Wilson for your unconditional support during **the good**, ~~the bad~~, and *the ugly*.

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Attributions

Manuscript 1:

Thomas E. Strayer III is a student in the Translational Biology, Medicine, and Health at Virginia Tech. He assisted with statistical analyses, analysis of data, and editing of this manuscript.

Rebecca Davis is a Family and Consumer Science health educator for Virginia Cooperative Extension. She serves as the Physical Activity Leadership Team LIFT Program Champion. She contributed practice-based evidence, materials, and feedback tools for this trial.

Dr. Samantha M. Harden is an assistant professor in Human Nutrition, Foods, and Exercise at Virginia Tech. She facilitated the partnership, managed and analyzed data, and edited the content within this manuscript.

Manuscript 2:

Thomas E. Strayer III is a student in the Translational Biology, Medicine, and Health at Virginia Tech. He assisted with statistical analyses, interpretation of data, and editing of this manuscript.

Rebecca Davis is a Family and Consumer Science health educator for Virginia Cooperative Extension. She serves as the Physical Activity Leadership Team LIFT Program Champion. She contributed practice-based evidence, materials, and participant survey responses for this trial.

Dr. Samantha M. Harden is an assistant professor in Human Nutrition, Foods, and Exercise at Virginia Tech. She assisted with designing the trial, managing and analyzing data, and editing the content within this manuscript.

Manuscript 3:

Dr. Sallie Beth Johnson is currently the Program Director of Health Sciences at Jefferson College of Health Sciences. She was formerly the Project Consultant and Research Coordinator in the Department of Family and Community Medicine for Carilion Clinic. As a member of the integrated research-practice partnership, she facilitated relationships with stakeholders of Carilion Clinic and assisted with identifying care coordinators as a point of referral for LIFT.

Dr. Samantha M. Harden is an assistant professor in Human Nutrition, Foods, and Exercise at Virginia Tech. She assisted with facilitating the integrated research-practice partnership, managing and analyzing survey responses, and editing the content within this manuscript.

Table of Contents

List of Appendices

List of Tables and Figures

Manuscript 1:

Manuscript 2:

Manuscript 3:

Introduction

Benefits, Prevalence, and Barriers of Strength-training for Older Adults

The additive effects of engaging in consistent strength-training over the lifespan can alter the aging process by decreasing the risks of chronic diseases [1], maintaining healthy bones, reducing joint swelling, improving muscle strength [2], and, ultimately, decreasing risk of falling in older adulthood [3-5]. While health benefits associated with strength-training are well known and established for all sexes, ethnicities, races, and ages of individuals [6], older adults represent a subgroup of the most sedentary or inactive individuals [7]. The current physical activity recommendations encourage older adults to engage in 150 total minutes of moderate-intensity aerobic activity and incorporate full-body, strength-training exercises on two or more days of the week [2]. However, only 16.7% of older adults are meeting the strength-training requirements [2]. This low rate of compliance with strength-training recommendations is a public health concern as 25% of the US population will be aged 65 and older by the year 2030 [8].

Older adults face physiological, psychological, and sociological barriers to meeting the current strength-training recommendations [9, 10]. Examples of such barriers may include but are not limited to; disabilities, prevalence of chronic disease [11], self-efficacy, or ones perceived confidence in their ability to successfully perform consistent physical activity [12], lack of enjoyment, demographics, social isolation, and lack of transportation [13, 14]. Physical inactivity increases as age increases (50-64, 65-74, and $\geq$ 75) and the prevalence of inactivity is higher for older adult women, Hispanics, and non-Hispanic blacks [15]. Similarly, there is a relationship between physical inactivity and a lack of education, increased Body Mass Index, and the incidence of living with a chronic disease [15].

Group Dynamics Approach to Increase Physical Activity Participation Among Older Adults

A range of evidence-based behavior-change strategies have been used to reduce barriers and improve physical activity behaviors of older adults [16] that are based on a variety of models (e.g., Transtheoretical Model) [17] or theories (e.g., Social Cognitive Theory) [18]. A group dynamics-based intervention is one approach that has been particularly successful with older adults [16, 19-21]. The group dynamics approach includes the active facilitation of strategies that promote a greater perception of group cohesion (e.g., group goal-setting, self-monitoring, group distinction, etc.) [22]. Group cohesion is "the dynamic process reflected by the tendency of a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs" [23]. The dimensions of cohesion focus on the individual and group attractions to the group task (i.e. exercise) and social environment [22].

Group dynamics-based physical activity interventions geared towards those of similar ages [24] may attract individuals who share similar cultural values, beliefs, and experiences among group members. This allows for social interaction leading to a greater attraction to the group-socially [14, 25]. Robins and others demonstrated that only a small percentage of older adults joined group-exercise programs for social interaction but of those who did, reported social interaction as a major benefit of group dynamics-based programs [26]. It is evident that group dynamics-based exercise programs offer opportunities for social support leading to greater intervention compliance and adherence [25, 27].

It is predicted that those who adhere to a strength-training program will be more active—since they are engaging in physical activity as part of the program [28, 29]. Unfortunately, effectiveness data are often reported as self-report or observational data [30]. Occasionally studies will report on one or two objective measures of effectiveness (e.g., timed- up-and-go, timed sit-and-stand, etc.), but rarely employ a comprehensive functional fitness assessment [14,

31]. Although 20 years of evidence supports the effectiveness of strength-training interventions for older adults, [32] the heterogeneous measures across strength-training interventions studies leaves paucity in the literature with regard to improvements in functional fitness.

Further, many evidence-based interventions are geared toward individuals with pre-existing medical conditions, exclude individuals based on severity of health conditions, or target residents of a medical care facility [31]. As a result, there are limited open-access physical activity programs for inactive older adults [33]. These restrictive eligibility criteria omit a large population of inactive older adults, which emphasizes a need for open-access physical activity interventions for older adults.

Translating Strength-training Interventions into Pragmatic Settings

RE-AIM Framework

Based on the low compliance with the physical activity recommendations for Americans, it is evident that strength-training programs for older adults are not reaching those in need nor are they scaled within practice settings; at least not enough to shift the degree to which older adults are engaging in strength-training activities. One way to systematically improve translation of evidence-based intervention into practice-based setting is through the use of the RE-AIM framework. RE-AIM stands for **R**each, or the number, proportion, and representativeness of participants compared to the total eligible audience; **E**ffectiveness, or the degree to which the intervention changes health outcomes and quality of life; **A**doption, or the number, proportion, representativeness of the settings and staff member that agree to deliver an intervention; **I**mplementation, or the degree to which the setting and staff delivers the intervention as intended; and **M**aintenance, or the sustained effectiveness for participants and sustained delivery across staff or within the setting [34].

The RE-AIM framework emphasizes balance between internal and external validity that results in generalizable research outcomes in pragmatic settings [34]. Utilizing the RE-AIM framework during the planning *and* evaluation stages of intervention development allows researchers to assess, 1) who should, versus did, receive the intervention (reach), 2) expected, versus actual outcomes (effectiveness), 3) who should, versus did deliver the intervention (adoption), 4) how the intervention should be, versus was, delivered (implementation), and 5) if the intervention will be, versus was sustained in practice [35]. Appropriate use of the RE-AIM framework will improve research relevance and inform potential translation of evidence-based research into practice-based settings [36].

The emergent field of dissemination and implementation science places an emphasis on identifying and aligning with the resources, mission, and values of the practice setting to determine potential program adoption and sustainability [37]. It is important to note that a 'one-size-fits-all' intervention will not be translated from setting to setting [38]. For example, adoption and sustainability may be hindered if a program has resource requirements related to facilities and equipment or the need to obtain a licensing agreement for delivery [39]. Adaptations (e.g., delivery mode, resources required, personnel, etc.) are often necessary to overcome the complexities of various settings [38]. Therefore, when considering translation of evidence-based programs, partnering with the intended delivery setting to transparently develop and report what, when, why, and for whom adaptions are made, may improve the likelihood of program adoption and sustainability [38, 40].

Integrated Research-Practice Partnerships

Rather than a top down approach, working through a participatory collaboration, or forming an integrated research-practice partnership (IRPP) between the intended delivery setting

and academics, may speed program translation [37]. An IRPP approach has shown to be an effective strategy for translating evidence-based physical activity interventions into a number of settings [41, 42]. A partnership approach allows research to be conducted *with* its intended community or practice rather than done *on* the community [43]. Together, they identify the problem, and work towards finding solutions to public health problems [41]. Academic researchers can apply their expertise for research-evidence program development and evaluation while health educators use their knowledge, experience, and resources within the community for program implementation and dissemination [44, 45]. As a result, members of the IRPP will reap the benefits from evidence-based practice and practice-based evidence beyond the length of the intervention [46]. Regardless of the setting (community or clinical), an IRPP should aim to attain sustainable and generalizable results [47] that have a public health impact and continue evolving the intervention for optimal implementation [38] beyond the submission of a publication [46].

Within practice settings that intervene to improve the health of the community, staff members are a key determinant of program uptake [37]. These staff members may be lay, peer, or professional health educators who deliver the programs in practice settings. The heterogeneity of health educators delivering interventions has been established for strength-training programs in particular [48]. Their primary concern is the development of long-term behavior change (i.e., that extends beyond the duration of an intervention) as well as programs that can be readily translated and maintained in practice [49]. Through an IRPP, researchers and invested stakeholders can assess overall perceptions of intervention feasibility, acceptability, and appropriateness prior to translation within the system [50]. Therefore, end users may perceive an intervention more suitable for delivery if it 'fits' [51] or, aligns with the mission, values and

resources of the practice-based setting [28, 44]. An IRPP may accelerate the implementation and dissemination of evidence-based programs into practice or real-world settings [37].

Integrated Research Practice Partnership: Cooperative Extension

One system in which researchers can establish an IRPP is the Cooperative Extension (herein: Extension) system. Extension is embedded within every state and territory within the US and serves a variety of communities across each state. Health educators within the system aim to "help people put scientific knowledge to work through learning experiences that improve economic, environmental, and social well-being." Community health educators have the expertise necessary to deliver evidence-based programs [48], have access to community resources (fitness centers, senior centers, etc.) [52], and have the willingness and desire to deliver evidence-based programs in a practice-based setting [49]. They prioritize programs that are readily translated and maintained in practice and that result in long-term behavior change (beyond the length of the intervention) [49]. Their span across the US allows for potential nation-wide dissemination of a strength-training intervention.

Integrated Research Practice Partnership: Health Care Systems

Another system that serves useful to partner with for promotion of health and wellness is the health care system. Advantages of partnering with clinical systems relate to its ability to reach an array of demographically different populations. On average, physicians within health care systems provide care to each patient 2.7 times per year [53] and are considered credible and trusted sources of health and wellness information by their patients [41]. Partnering with health care systems has gained momentum as they have shown to be effective for diabetes prevention [54], reduction of heart disease, mortality [55], BMI and weight loss [56], etc. There has been a push for physicians to advise their patients to engage in adequate physical activity to meet the

recommendations, however, a routine office visit leaves limited time for physicians to discuss the importance of physical activity [57]. Another barrier of physical activity promotion within the health care setting includes lack of resources (education, training, personnel, space, etc.) [41]. As a result, physical activity interventions that promote overall health are often not translated and sustained within practice beyond the length of the intervention [58].

Integrated Research-Practice Partnership: Academic- Clinical- and Community Stakeholders

Individual-level counseling or individual-based interventions are not practical in a clinical or community settings to reach a significant proportion of patients and show positive effects on strength-training behaviors [59]. Group-based interventions within a practice-based setting have the potential to reach a greater number of the target population and have demonstrated lasting influence on physical activity behaviors [58]. This provides justification for group-based strength-training interventions to be promoted by health care providers and delivered by community health educators through the work of a IRPP [41] to reduce the time burden on physicians [57]. Forming an IRPP between researchers-, physicians-, and community stakeholders enables the development of an intervention that aligns with the clinical structure, community needs, and overall goal for promoting physical activity (e.g., fall-risk reduction, osteoporosis, prevention or prolonging the onset of chronic diseases, etc.) [53, 60]. Overall, establishing an IRPP between academic-clinical- and community partners may bridge the gap of research-based knowledge and practice-based expertise for translation and dissemination of effective and relevant interventions to priority populations within real world settings [37].

Overview

This dissertation includes a series of manuscripts that focus on the process of working through an IRPP to select, adapt, deliver and transparently report real-world adaptations made to

an evidence-based strength-training intervention for older adults, Lifelong Improvements through Fitness Together (LIFT). The first manuscript describes the process by which an evidence-based strength-training program underwent research- and practice-based adaptations through the scope of an IRPP with Extension to develop a program the fits the mission, values, and resources of the intended setting. The aim of Manuscript 1 was to describe the process by which an evidence-based intervention was adapted to meet the needs of a community entity as well as the initial Adoption, Implementation, and Maintenance dimensions of the RE-AIM framework. To generate evidence in support of the adapted strength-training program, Manuscript 2 evaluates the initial Reach of older adults and Effect on functional fitness of the adapted program, LIFT, through an IRPP with a community entity. Manuscript 3 outlines the development, processes, and temporal outcomes of an IRPP approach aimed at linking stakeholders across the academic-clinical-community continuum to assess feasibility, acceptability, and appropriateness outcomes associated with Implementation of a LIFT referral scheme. It is concluded that an IRPP, although time intensive, may be an effective approach to report real-world adaptations based on the needs of the delivery setting without compromising effects of an evidence-based strength-training intervention for older adults.

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Manuscript 1

Informed Adaptations of a Strength-Training Program through a Research-Practice Partnership

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Abstract

Efficacy and effectiveness data for strength-training programs targeting older adults have been well established, but it is evident that they are not translated within practice-based settings to have a public health impact, as most (~90%) older adults are not meeting strength-training recommendations. Strength-training interventions developed, delivered, and evaluated in highly controlled settings (e.g. eligibility requirements, certified instructor, etc.) may not reflect real-world needs. One strategy to improve these outcomes is to work through an integrated research-practice partnership (IRPP) to plan and evaluate an intervention to better fit within the intended delivery setting. The purpose of this study was to describe the IRPP method by which academic and practice representatives can partner to select and adapt a best-fit strength-training program for older adults. This work was planned and evaluated using the RE-AIM (reach, effectiveness, adoption, implementation, maintenance) framework, applying the AIM dimensions to complement the methodology of the partnership. In this pragmatic work, members of the IRPP adapted the evidence-based program, Stay Strong, Stay Healthy (SSSH) into a new program, Lifelong Improvements through Fitness Together (LIFT). Of the health educators who agreed to be randomized to deliver LIFT or SSSH (n=9), four were randomized to SSSH and five were randomized to deliver LIFT. Fifty percent of educators randomized to SSSH delivered the program whereas 80% of the health educators randomized to LIFT delivered the program. The health educators deemed LIFT more suitable for delivery than SSSH, self-reported high rates of fidelity in program delivery, and intended on delivering the program in the following year. In conclusion, this study provides transparent methods for using an IRPP to adapt an intervention as well as preliminary outcomes related to adoption, implementation, and maintenance.

Introduction

A number of strength-training programs for older adults that include home-based resistance training, supervised and unsupervised strength-training, and strength-training with groups of individuals have been effective [1-3]. Unfortunately, less than 10% of the older adult population are meeting strength-training recommendations [4]. This indicates that while the efficacy for these programs is well established, they are not being translated within practice settings to have a public health impact.

Many evidence-based programs restrict their eligibility requirements based on medical status such as having osteoarthritis, living with diabetes, or those who identify with a specific gender [5-7]. Similarly, some programs require delivery agents to be trained or certified fitness instructors through an external affiliation (i.e. American College of Sports Medicine) [8]. These highly controlled conditions (e.g. eligibility restrictions for participants, certification requirements for delivery personnel, etc.) focus primarily on internal validity under best practices and may impede successful intervention implementation from one setting to the next due to limited attention on external validity [9-11].

Limiting the 'fit' of an intervention leads to the absence of full penetration within a delivery setting and potential reach of the priority population, a shortcoming of delivery agents willing to adopt the intervention, and ultimately, inadequate implementation of the intervention [12, 13]. To improve the potential for an intervention to be translated in the intended delivery setting, interventions should be developed considering both internal and external validity factors (e.g. will the intervention work for multiple subgroups of populations in a variety of settings and will it have greater advantage over alternative interventions?) [11]

One way to systematically capture these factors is to plan and evaluate a strength-training intervention using the RE-AIM (Reach, Effectiveness, Adoption, Implementation, and Maintenance) framework [14]. Accurate reporting of these components may lead to the development of an intervention that will have long-term, practical application and pragmatic fit within the practice-based setting. There remains a publication bias toward effectiveness outcomes. Intervening to improve adoption, implementation, and maintenance outcomes is nascent for strength-training promotion interventions for older adults [11, 15].

To improve adoption, implementation, and maintenance outcomes of behavior change interventions, interventions should identify and align with the existing resources, mission, and values of practice-based settings and staff (e.g. lay-, peer-, or professional- health educators) [16, 17]. Health educators have the expertise, access, and willingness to deliver community- and evidence-based programs within their setting if they are easily translatable and sustainable in practice [13, 18, 19]. The implementation strategies used to adopt and integrate evidence-based health interventions into specific settings, should be deemed acceptable, appropriate, and feasible for those delivering and receiving the intervention in a specific clinical or community setting [9, 20]. For example, an intervention will not be delivered with fidelity if it does not 'fit' the mission and values of the individual- or setting-level delivery setting or the priority population, resulting in compromised effectiveness of the intervention [18, 21-23].

One system with a particular mission to adopt and deliver effective behavior change interventions is the Cooperative Extension (Extension) system. Extension health educators represent communities and may serve as appropriate facilitators of behavior change interventions related to strength-training because of their pre-existing relationships with community members and leaders, access to community resources, and understanding of their communities needs [24].

However, health educators are often compelled to deliver a variety of programs addressing the needs of varying priority populations (adolescents, adults, seniors, etc.) based on an annual situational analysis conducted in their counties [18]. Selection and delivery of programs is often based on personal experience, observability, or a top down dissemination approach where the academic researcher produces a program that the health educator will deliver [25]. This selection and delivery approach disregards specific community needs, values, and ability, which may lead to poor translation of effective, evidence-based strength-training programs into a practice-based setting [25]. Furthermore, the process by which these health educators can work with researchers to swiftly and effectively select and adapt an intervention has yet to be reported in the literature.

Through an IRPP, health educators and researchers equally contribute toward identifying a public health concern, design an intervention that is feasible, acceptable, and appropriate for delivery within the intended setting, and transparently report lessons learned to advance the utility and translation of the intervention within the intended delivery setting [9, 26, 27]. As a result, health educators may perceive a program as more suitable and acceptable for delivery if it has been collaboratively adapted in accordance with the underlying program principles that incorporates the ideas and needs of those delivering and receiving the program [9, 28-30]. Establishing an IRPP between academic and community partners may bridge the gap of research-based knowledge to practice-based expertise for accelerated implementation and dissemination of evidence-based, effective interventions into real-world, practice settings [31, 32].

The overall purpose of this paper is to describe the process by which an evidence-based, strength-training program underwent research- and practice-based adaptations through the scope of a partnership to develop a program that would be **a**dopted by community health educators,

implemented throughout the community with fidelity, and **m**aintained in a practice-based setting, beyond the life of the intervention [31, 33]. Described within is the process of incorporating, reporting, and testing the feasibility or fit of evidence- and practice-based adaptations into a strength-training intervention based on the needs of the health educators and the priority population.

Method

Integrated Research-Practice Partnership

In order to introduce quality programs that focus on physical activity within Virginia's Extension system and improve older adult individual-level strength-training compliance, an IRPP was formed among health educators of Extension and behavioral and implementation scientists in 2015. Specifically, the partnership consisted of eleven health educators across each of the four districts of Virginia Extension who had previously delivered physical activity programs to their community and one exercise specialist (statewide Exercise leader of Extension). The partnership also included three graduate research assistants. The stakeholders involved in the partnership labeled themselves as the Physical Activity Leadership Team. Members of the Physical Activity Leadership Team agreed to meet biannually in-person at a central location and biannually via WebEx for regular check-ins, program updates, and adaptations needed by members to better suit their needs for delivery of physical activity programs. All study procedures were completed in accordance with and with the approval of the Virginia Tech Institutional Review Board (see Appendix A), participation was voluntary, and all data were kept confidential. All participants gave written informed consent before participation.

Intervention Identification, Selection, and Structure

Based on the research- and practice-based evidence of effective and sustainable strength-training programs for older adults in Extension, Stay Strong Stay Healthy (SSSH) [34] and Better Bones and Balance [35] were presented to the members of the partnership within Virginia Extension. Based on the needs and constraints of Virginia Extension health educators, SSSH was the program of choice by the Physical Activity Leadership Team.

Each SSSH session is intended to last one hour and consists of strength-training, balance, and flexibility exercises, and cool-down stretches (outlined in Figure 1). Functional fitness measures are collected and recorded before and after completion of the program to assess intervention effectiveness (see Appendix C for the functional fitness protocol and scoring sheet). Participants are encouraged to attend one to two sessions per week for 10 weeks but no behavioral change strategies are incorporated into the sessions (i.e. goal setting, self-monitoring, group distinction, etc.).

Figure 1: Strength-training exercises and cool down stretches of LIFT and SSSH

To summarize, the core elements of SSSH are: 10-20 in person sessions, a warm-up, eight strength-training exercises, and three cool down stretches [34]. The underlying core components of SSSH can be seen in Table 1.

Table 1: Underlying core components of LIFT versus SSSH

Core Component	**SSSH**	**LIFT**
Duration	1 hour sessions, 1 to 2 times a week for 8 weeks	1 hour sessions, 2 times a week for 8 weeks
Audience	Insufficiently active, aging men and women	Insufficiently active, aging men and women
Behavioral Components	No strategies used	Observational learning, self-monitoring, self efficacy, group dynamics, and relapse prevention
Exercises	Active warm-up, 8 core strength-training exercises, and cool down	Active warm-up, 8 core strength-training exercises, and cool down
Group Dynamics	No strategies used	Small groups for interaction, group names; participant lead exercises; friendly competition, social support, group goals
Goal	Increase muscle and bone density to decrease osteoporosis and frailty	Enhance overall functional fitness through improved strength, flexibility, and balance

However, the Physical Activity Leadership Team requested evidence- and practice-based adaptations before translating SSSH into the Virginia Extension system. These adaptations (outlined in Figure 2) included 1) the facilitation of group dynamics-based behavior change strategies; 2) a nutrition education component embedded within the program to align with the Virginia Extension mission 3) physical activity and fruit and vegetable consumption tracking (i.e., self-monitoring [36]); and 4) the reduction of in-person time commitment (delivery of the program for 8 weeks versus 10 weeks). The newly adapted program implemented across the state of Virginia is called Lifelong Improvements through Fitness Together (LIFT).

Figure 2: Evidence- and practice-based adaptations of LIFT

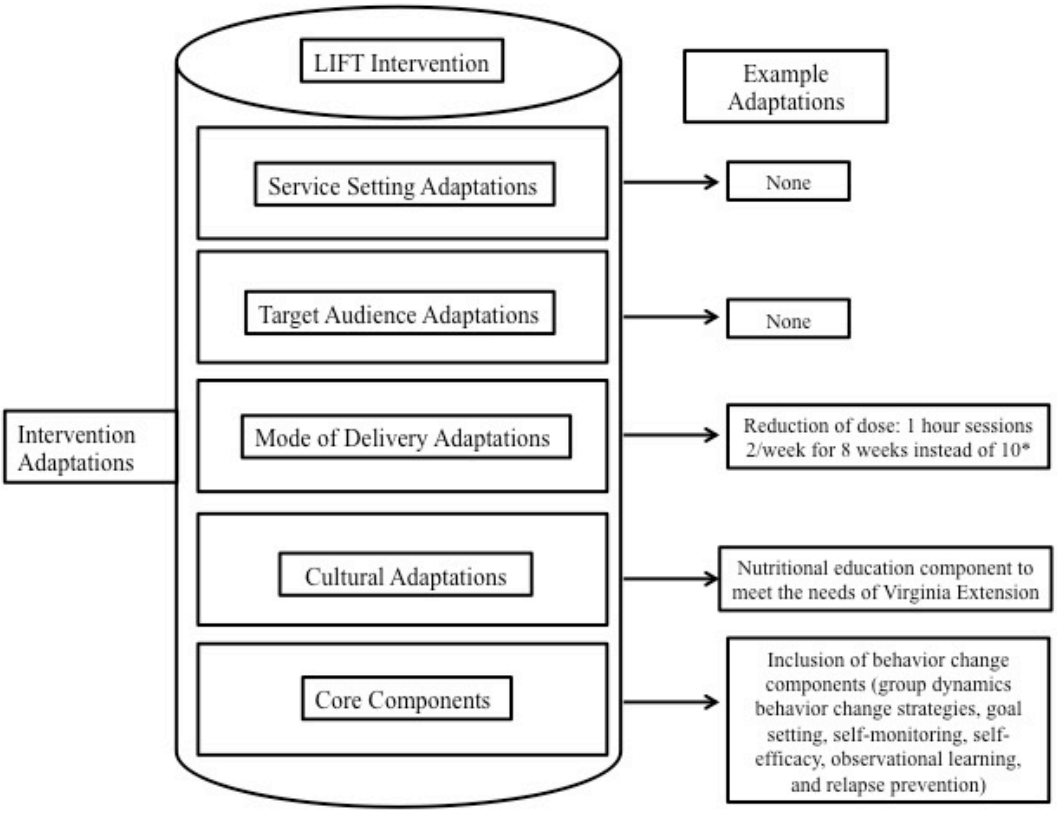

Figure is adapted from Chambers & Norton, 2016. The Adaptome: Advancing the Science of Intervention Adaptation
*SSSH was also adapted from a 10 week program to an 8 week program however, those results are not yet published

Adaptations to Intervention

Group Dynamics. To translate SSSH into Virginia Extension system, the exercise specialist of the Missouri Extension system delivered an in-person training on SSSH to the exercise specialist and one health educator of the Virginia Extension. While at the training, Missouri health educators that have delivered SSSH to aggregates of individuals, anecdotally noted that 'camaraderie' was a by-product of participation in SSSH. However, camaraderie is not a 'natural' by-product of working out among a group of individuals. For example, anyone can attend a weekly group fitness exercise class without actively engaging or communicating with the people around them. Implementing a group dynamics-based approach in which communication and interaction is facilitated between participants within a setting can foster group cohesion [37] or, "the dynamic process reflected by the tendency of a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs" [38].

A group dynamics-based intervention is one approach that has been successful with older adults [39]. This approach includes the active facilitation of strategies (e.g., goal-setting, friendly competition, group distinction, etc.) to promote a greater perception of group cohesion [37]. The groups' cohesiveness should be actively facilitated or targeted through group dynamics-based strategies to enhance the feeling of belonging and encourage communication among group members [40] over the course of the intervention. Health educators delivering LIFT were trained on how to identify and target the underlying group dynamics-based principles (goal-setting, group distinction, roles, friendly competition, etc.). Prior to delivering LIFT, health educators were provided with strategies to satisfy the underlying group dynamics-based principle of the session (e.g. encouraging members to come up with a team name) but could adapt the strategies

to meet the needs of their priority population (e.g. instead of identifying with a group name they could all wear similar colored shirts). Health educators understood the importance of transparently reporting the planned change or adaptation made from the strategy provided.

Nutrition Education. Whereas most Extension programs focus on nutrition education and then integrate components of physical activity [41], LIFT is an exercise program that incorporates nutrition education. This was done to meet the mission and values of Virginia Extension. Each LIFT session included a short nutritional education piece concerning the importance of increased fruit and vegetable consumption. Delivery agents were able to present the provided educational information to their participants in concurrence with the in-person LIFT session.

Self-monitoring behavior. To influence motivation towards long-term behavior change, participants are encouraged to track their physical activity behaviors and fruit and vegetable consumption outside of the LIFT program. Participants were provided with a self-tracking sheet that they could complete at their own leisure. Self-tracking and self-monitoring of behavior helps individuals regulate their behavior and stay motivated towards long-term behavior change [36].

Dose. Reported results of SSSH inform that health educators deliver the intervention twice a week for 10 weeks [34]. To align with the current (however not published) dose of SSSH within Missouri Extension, Virginia Extension delivered LIFT twice a week for 8 weeks. This ensures that participants are engaged in adequate strength-training to meet the physical activity guidelines but is not burdensome to those delivering or receiving the intervention.

To summarize, the core components of LIFT are: 16 in person sessions, the same warm-up, strength-training exercises, and cool down stretches from SSSH [34], and the inclusion of behavior change strategies that fit the mission and values of Virginia Extension, the health

educators delivering the intervention, and older adults receiving the intervention (Table 1: Underlying core components of LIFT versus SSSH comparison)

Recruitment and Training

In 2015, all Masters trained and professional Virginia Extension health educators (n = 52) were invited to attend a two-day physical activity training hosted by the lead and senior authors. Thirty-four Virginia Extension agents signed up to attend. Over the course of two days (five hours on day one and six hours on day two) all agents learned the following: 1) the primary evidence-based principles of reaching physical activity behavior change, 2) strength-training exercises (proper form, cues to deliver, safe speed, etc.), 3) the importance of evaluation tools (surveys, functional fitness assessment, and demographic information), and 4) personal experience and practice in leading groups through strength-training exercises. Specific to LIFT, health educators received a thorough information session, via PowerPoint Presentation, introducing the evidence-based strategies and specifics of the program. The information session was followed by a two-hour demonstration consisting of the eight, full-body exercises, functional fitness assessments, and a testimonial from the perspective of a health educator who has delivered physical activity interventions within communities she serves for over 10 years. Health educators also spent two hours of experiential learning and performing a sample LIFT session (training materials available upon request).

Before a full launch of LIFT across the state of Virginia, it was essential to test the feasibility of the adaptations and build the evidence-base of the program. Health educators interested in participating in a feasibility trial (n=13) of LIFT versus SSSH were invited to attend a three-hour, in-person information session where they were 1) re-familiarized with the adapted program, LIFT and 2) given repeat demonstrations of the eight strength-training exercises and

functional fitness assessments in January of 2016. Eligible attendees included health educators who either a) attended the training in 2015 or b) were members of the Physical Activity Leadership Team. The purpose of the feasibility study was to evaluate the potential reach of LIFT and practicality of implementing program adaptations for sustainable delivery within the Virginia Extension system, ensure that the evidence- and practice-base adaptations did not compromise the effectiveness of the intervention, and determine health educator level-adoption, and maintenance, or intentions of continued delivery in a community-based setting.

Measures

RE-AIM

Reach and intervention ***e***ffectiveness data were collected from pre- and post-program surveys and functional fitness assessment for the feasibility study. However, those data are part of a larger trial and are not reported within this manuscript. ***A***doption data were collected as the proportion of eligible and interested health educators who agreed to deliver LIFT or SSSH as part of the feasibility study for assessment. Health educator participants also completed weekly process evaluations (see Appendix B, for an example process evaluation) to capture the ***i***mplementation and feasibility of current adaptations and further report real-world adaptations made during class sessions. Although health educators were free to change the suggested activities of the program, adaptations were still recorded to ensure they did not deviate from the underlying core components of LIFT and to gather a repository of adaptations that captures for whom, what, how, and when [42] adaptations were deemed necessary by health educators for their priority population. The process evaluations also informed the partnership of self-report program fidelity, or the extent to which the program was delivered as intended in regards to the posed adaptations made in alliance with each activity, with results reported in five activity

categories (e.g. warm-up activity, group-dynamics strategy, exercises, cool down, and overall program delivery). Proportions of program fidelity were calculated based on self-reported delivery adherence by activity, when compared to the total number of sessions delivered. Implementation fidelity was deemed appropriate if changes made during the LIFT program did not deviate from the underlying core principles (group dynamics-based strategies, exercises, dose, frequency, etc.). ***M***aintenance was operationalized as the health educators' intent to deliver (yes= intend to deliver; no= do not intend to deliver) the program in the future.

Results

Adoption

Of the 13 eligible and interested health educators who expressed the need for translating LIFT into their community, 9 (70%) agreed to deliver LIFT or SSSH as part of a feasibility trial. Five of the nine health educators were randomized to LIFT and four delivered the program to older adults in the community. Four of the nine health educators who agreed to participate in the feasibility trial were randomized to SSSH and two delivered the program to older adults in the community.

Using the denominator of 9 (those eligible and agreed to deliver), 4/9 (44%) delivered the LIFT program in practice, whereas 2/9 (22% of those eligible and agreed to deliver) delivered the SSSH program in practice. However, using the denominator of 13 health educators i.e., total number eligible and *interested* in delivering the program, the proportion delivering LIFT was 4/13 (31%) whereas the proportion delivering SSSH was 2/13 (15%).

Implementation: Warm-Up: Health educators reported on delivering the program with high fidelity 58% of the time for warm-up exercises. When a health educator reported an adaptation

during the warm-up activity, the adaptation included, "completed high knees and grapevine exercises instead of marching in place while pumping arms."

Group Dynamics-based Activities: Health educators reported high fidelity to the group dynamics-based activities 64% of the time. However, when an adaptation was reported, they stated within the adaptation that the activity did not fit their priority audience or there was not sufficient time within the session to complete the activity. An example adaptation reported was, "Instead of encouraging everyone in the group to perform the specific activity, I would ask for volunteers to complete the activity to save on time".

Exercises: Health educators reported doing more repetitions of exercises than was prescribed in the program manual 38% of the time. Only one health educator reported doing less than the number of repetitions prescribed (i.e., her participants did not complete a second set of arm curls and overhead press exercises throughout the duration of the LIFT however, they increased the number of repetitions in the first set to 12). Health educators reported changes in the equipment used to complete exercises 10% of the time. With regard to equipment changes, an example adaptation included, "used resistance bands in place of dumbbell weights."

Cool-down: Health educators reported delivering the cool down stretches as intended 89% of the time. When a change in exercise was made, health educators reported the adaptation as, "participants wanted to walk around the gym instead of stretch" or "completed different stretches."

Overall program delivery: Health educators reported delivering the program as intended 99% of the time, overall.

Maintenance

One hundred percent of the health educators who delivered LIFT reported 'yes' that they had intentions to deliver LIFT in the future. Of those who delivered SSSH, 100% confirmed their intentions (yes) to deliver LIFT in the future instead of SSSH. The health educators who delivered SSSH expressed their desire to incorporate the nutrition component and active facilitation of the social environment for their older adult participants. To date, five of the six health educators have continued delivery of LIFT within their community to different cohorts of older adults. The health educator not delivering LIFT has since left Extension.

Discussion

The overall purpose of this paper was to describe the process by which an evidence-based intervention underwent research and practice-based adaptations through an IRPP approach. Results of preliminary fit of the adapted intervention were based on the **A**doption, **I**mplementation, and **M**aintenance dimensions of the RE-AIM framework. Together, the IRPP identified an evidence-based program, adapted it to meet the mission and values of the Extension setting and staff, delivered the intervention, and transparently reported any further, real-world adaptations made during delivery.

LIFT, the adapted intervention of SSSH, was delivered in practice at a higher rate than the original program, although the sample size was too low to determine significance (**A**doption). Although SSSH continues to show positive effects in strength-training behavior and has been delivered and sustained within the Missouri Extension system for over ten years, the adapted intervention, LIFT, was deemed more appropriate than SSSH within the intended setting for the priority population, which is unsurprising as LIFT was adapted to fit the needs, values, and resources of the existing delivery setting (**I**mplementation) [12, 34]. Working through a research-practice partnership built buy-in from stakeholders that helped facilitate their desire to

understand and capacity to employ the underlying program principles that aligned with the proposed adaptations (i.e. group dynamics, self-monitoring, and dose) and deliver the program with a high degree of fidelity to obtain intervention effectiveness [12, 30, 43]. Continued efforts of the IRPP to promote the 'appropriateness' of LIFT for older adults across the state of Virginia may improve the adoption, implementation, and maintenance rate of LIFT and may have a greater effect on the strength-training behaviors of older adults across the state.

Evidence-and practice- based adaptations are planned and executed to improve the feasibility, acceptability, appropriateness and overall fit and delivery of an intervention in a given system. Adaptations are not to be mistaken for program deviations or unplanned changes made throughout an intervention that have a negative impact on system-level or participant-level outcomes [21, 44]. The process described in this manuscript aimed to contribute to the literature identifying what, when, and by whom adaptations were made. Communicating to members of the research-practice partnership the importance and utility of the information provided with transparent reporting of adaptations made to the program manual is a key component to improving the potential for satisfactory intervention fidelity [45]. However, the fidelity data specific to this intervention were difficult to interpret for a number of reasons. First, to the authors' knowledge, there was not an existing, psychometrically tested fidelity checklist for these interventions. The fidelity rate should be interpreted with caution. Second, the fidelity data were collected as self-report perceptions of delivery, meaning, that although they were reporting changes to the activities, they were still achieving the goal of the program (e.g. improve strength of older adults, engage in social activities to build cohesion, etc.). Findings were brought to the health educators of the research-practice partnership and found that, although the data related to individual components of the program (warm-up, group dynamics activities, exercises, cool

down, and overall program delivery) did not indicate that they were delivered with 100% fidelity, health educators believed, or reported high fidelity that the overall program was delivered as intended based on the adaptations made.

It can be concluded that although health educators were reporting adaptations being made or changing the 'form' of the warm-ups, group dynamics-based activities, exercises, or cool downs, those adaptations were not changing the 'function' of the activity. Meaning, the adaptations being made were still targeting the underlying program principles and core components of LIFT [46]. It is important to note that "manualized" interventions are nearly impossible to ensure across multiple, practice settings and that adaptations should be encouraged if they 1) align with the underlying program principles 2) can be broadly delivered by delivery agents and 3) best meet the needs of the participants [44]. Future work is needed to develop, test, and validate a psychometric process evaluation to more effectively gather fidelity data for this type of intervention.

Providing health educators who will deliver LIFT in the future with a repository of changeable strategies to target the underlying core components of LIFT, will allow them to better meet the individual needs of their participants [47] and may further increase program feasibility for delivery personnel within a setting [9]. This strategy enables health educators to tailor the intervention to improve the overall appropriateness, acceptability, and fit across a wide variety of settings for participants with varying needs (i.e. senior centers with individuals in wheelchairs, clinics with patients at risk for falling, hospitals with patients diagnosed with chronic illnesses or mobility restrictions, etc.) without compromising the effectiveness of the intervention [9, 44]. Having a centralized resource that includes the types of adaptations made, for whom they were

made for, and at what point in the intervention they were made will better inform the adoption and implementation decisions of health educators interested in delivering LIFT [42].

Inevitably, real-world adaptations often occur in all practice settings and implementation with satisfactory fidelity to the intervention design is rarely achievable [22, 44]. Through an IRPP approach, research team members were able to conclude that the adaptations made in practice and reported on within the process evaluations adhered to the underlying program principles of LIFT. This indicates four things: 1) the process evaluation approach (and analysis) will be amended to better reflect the degree to which the program aligns with research-based principles, 2) although the process evaluations are self-report, the intervention effects were not compromised (effectiveness data were collected as part of a larger trial, reported elsewhere) and therefore the process evaluations may provide support for relative intervention adherence or satisfactory fidelity, 3) health educators are able to make pragmatic adaptations that adhere to underlying program principles, and 4) through the use of process evaluations we were able to highlight how to better report the process of real-world adaptations occurring and to better understand how the adaptations impact those at the individual level in different settings [18, 25, 44, 48].

There were few limitations to be addressed. First, research members of the partnership stressed the importance of transparent communication between all members of the partnership and felt it would be unfair to blindly randomize members to deliver LIFT or SSSH. Instead, there was open communication about the importance of testing the feasibility of the two interventions within the Virginia Extension system and further build the evidence-base for LIFT within Virginia. However, once each program was assigned to the respective communities, health educators expressed disappointment in being assigned to the SSSH protocol, as they wanted to

incorporate behavior change strategies and actively interact with their study participants. The research team further elucidated the importance of the feasibility trial, however, there may be program drift that went undetected due to the small sample size [44]. Second, the research team used a convenience sample of health educators due to their excitement and willingness to deliver a strength-training program to older adults within their communities. However, we understand the barriers of delivering physical activity interventions, specifically strength-training, and future research will be needed to target health educators with lower self-efficacy for delivering such programs. Lastly, the results of this trial are only generalizable to the health educators of Virginia however; recruitment of health educators across a variety of counties within Virginia allowed the research team to analyze the results from multiple regions and different settings across the state. To date, the partnership is utilizing external relationships to expand the delivery of LIFT across multiple states.

Conclusions

The IRPP implementation strategy allowed the research team to work with the intended delivery setting and the health educators within the system to improve the quality of the intervention integrated within the setting. Although this work was conducted in Extension, the method can be applied in other practice settings. Through results of this study, it is evident that working through an IRPP and involving stakeholders in the design and delivery of an intervention is key in the successful implementation of an intervention. This approach allowed for real-time, transparent tracking of further adaptations needed by the health educators and intervention participants, did not compromise the effectiveness of the program for the priority population, and resulted in relatively successful program fidelity.

Together, researchers and invested stakeholders can identify a need that targets a specific community, design or tailor an existing intervention to improve the overall fit within the community, test the implementation outcomes (feasibility, acceptability, appropriateness, sustainability, etc.), and determine if the intervention is ready for full-scale translation into a specific setting. The process of implementing an intervention into a specific setting should be nonlinear and simultaneous, meaning that the IRPP research-practice partnership should design, test, and deliver the intervention while planning for long-term sustainability from the beginning.

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Manuscript 2

Use of an Integrated Research-Practice Partnership to Improve Outcomes of a Community-Based Strength-Training Program for Older Adults: Reach and Effect of Lifelong Improvements through Fitness Together (LIFT)

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Abstract

Only 17% of older adults meet the recommendations for two days of full body strength-training that is associated with improved functional fitness; reduced risk of falls; and reduced morbidity and mortality rates. Community-based interventions are recommended as they provide supportive infrastructure to reach older adults and impact strength-training behaviors. Scalability and sustainability of these interventions is directly linked with setting-level buy-in. Adapting an intervention through an integrated research–practice partnership may improve individual and setting-level outcomes. The purpose of this study was to evaluate the initial reach and effect of a locally adapted, health educator-led strength-training intervention; Lifelong Improvements through Fitness Together (LIFT). LIFT was compared to an evidence-based exercise program, Stay Strong; Stay Healthy (SSSH). Intervention dose and mode were the same for LIFT and SSSH, but LIFT included behavioral change strategies. Older adult functional fitness was assessed before and after the 8-week strength-training intervention. Health educators who delivered LIFT and SSSH were able to reach 80 and 33 participants, respectively. Within group comparison of LIFT participants showed significant improvements in all functional fitness measures whereas within group comparison of SSSH participants showed only significant improvements in 5 of the 7 functional fitness measures. In conclusion, this study provides preliminary evidence that practice- and research-based adaptations had greater reach and did not compromise the effectiveness of an existing evidence-based strength-training intervention.

Introduction

Older adults (≥65 years of age) represent the fastest growing and most inactive subset of individuals in the United States [1]. Although two days of full-body strength-training recommendations were included in the physical activity guidelines a decade ago [2], only 17% of older adults meet the recommendations for strength-training [3]. This low rate of compliance with strength-training recommendations is a public health concern.

Physiologically, older adults lose muscle mass and strength with increased age and physical inactivity [4, 5]. Muscle weakness hinders older adults' ability to continue their daily routine and remain functionally fit, or perform everyday activities safely and independently without tiredness or weakness [6]. Individuals with weakened quadriceps, hamstrings, or hip extensors muscles have reported slower walking speed and velocity [4], issues climbing stairs, and problems with standing from a seated position [7]. Similarly, upper body muscle weakness is associated with decreased ability to perform daily household chores such as folding laundry, gardening, and carrying grocery bags [8]. Older adults who engage in strength-training exercises are able to maintain or improve muscle mass and strength [7] along with remaining functionally fit as they age [6].

Functional fitness can be objectively measured through a previously validated seven-item test [6] and should be a key outcome of interest associated with strength-training interventions. This measure was initially reported as 'user-friendly' by those administering the test and 'enjoyable' by those participating in the test [6]; however, it is often not used in its entirety [9, 10]. For example, two community-based programs—EnhanceFitness [9] and Strong-for-Life Program [10]—used an adapted version of the Rikli and Jones protocol in practice to determine the effect of the intervention on functional fitness.

While there are a number of efficacious and effective community-based strength-training programs for older adults [11], there is little evidence indicating that the interventions are successfully translated into practice-based settings beyond the length of the intervention. This lack of translation may be a result of a top-down dissemination approach where an academic researcher produces a program and suggests that a community should deliver it [12]. This development and delivery approach often disregards community-specific needs, values, and abilities to deliver research-developed programs [13]. For example, a community may lack the resources (e.g., location, equipment, etc.) or staff with expertise to deliver evidence-based strength-training programs [14]. An evidence-based program will have a much greater public health impact if they are integrated into a practice-based setting and delivered consistently beyond the length of the intervention [15].

Rather than a top down approach, an integrated research–practice partnership (IRPP) between communities and research academics may speed program translation into a practice-based setting [16, 17]. Through an IRPP, academic researchers and invested communities can work collaboratively to develop and deliver an intervention that adheres to the evidence-based principles of the intervention *and* complements the setting in which it will be delivered [18]. This approach encourages equal buy-in from both the academic research team and the community delivering the program [19]. Communities with buy-in of an evidence-based program may deem it more suitable for delivery if it has been adapted in accordance with the mission, values, and resources of the practice-based setting [20-22] and therefore will ultimately reach more of the target population and have a greater effect [19] on functional fitness. An IRPP approach may bridge the gap of translating effective, evidence-based programs into community-based settings beyond the length of the intervention [16].

One delivery setting that has the capability of delivering evidence-based programs to a large proportion of older adults is the National Cooperative Extension system (herein: Extension) [23]. For years, Extension-delivered programs focused primarily on educating individuals about food and nutrition with the incorporation of physical activity as a less important aspect of educational programs [24]. Since physical activity objectives were added to the National Institute of Food and Agriculture strategic plan in 2014, efforts to incorporate physical activity programming in Extension are inchoate.

With this strategic goal in mind, county-based health educators of Extension serve as appropriate facilitators of physical activity programming. As one example of this potential impact, over 30 states deliver a version of an exercise-science based Strong Women, Strong Bones [25] program for older adults whereas over 20 states deliver a statewide walking program [26]. Related to the former, in a recent dissemination trial of Strong Women, Strong Bones, of the 881 people trained on the program, 43% were Extension professionals [25]. Most of the states currently delivering the program in practice adhere to the core elements of the exercise science of Strong Women, Strong Bones, but few programs have shared their adaptations to the program nor their ongoing reach or effect in the community. One investigator has shared branding adaptations and the continued impact on fall prevention of the exercise science principles of the program [27]. This program was renamed Stay Strong, Stay Healthy (SSSH) to attract male participants; the outcome paper reports that SSSH was delivered by 34 Extension nutrition and health specialists to a total of 808 older adult participants. SSSH participants were able to significantly improve in all measures of the Rikli and Jones functional fitness assessment protocol from pre-program to post-program [27].

In order to bring the exercise science principles of Stay Strong, Stay Healthy to a new population and setting, adaptations [28] were required to fit the mission, values, and resources of the state system [16, 18]. Additionally, when adaptations are made, there are concerns for internal and external validity of the intervention (i.e., does the adapted program work with this new population, in this new setting?). This provides a critical need to describe the IRPP process and the outcomes that led to program adaptations. The degree to which the adapted program can reach community members, improve objectively measured functional fitness outcomes, and build capacity among county-based health educators to continue to support the program within their state must be evaluated.

Taken together, (1) community delivered evidence-based programs are necessary to reach and impact older adult physical activity behaviors [29]; (2) these behaviors should be objectively measured to give veracity to the community-based intervention [30]; (3) focusing on the reach and representativeness of the target audience is essential for improved generalizability; and (4) in order to improve system level perceptions of fit, a participatory approach is recommended [17, 31]. The purpose of this feasibility study was to evaluate the potential reach and effect of a locally adapted version of SSSH. It is hypothesized that adapting an intervention to meet the needs of the delivery setting may increase the reach and effect of evidence-based strength-training programs for older adults [16].

Materials and Methods

Program Design

In 2015, an IRPP among county-based health educators and the new exercise specialist of Virginia Cooperative Extension was formed. Through a needs assessment, it was identified that physical activity promotion among aging adults was a high priority for the IRPP and the

communities they served. One health educator on the IRPP was trained on the Strong Women, Strong Bones [25] program when she worked in a different state Extension system. One critique of the Strong Women, Strong Bones program for Extension was that the program name was not as inclusive for male participants. In looking to the peer reviewed literature, members of the IRPP found Missouri Extension's Stay Strong, Stay Healthy program [27]. This program was open to and actively recruited male participants, and, therefore, was the targeted program rather than the original Strong Women, Strong Bones intervention.

However, additional adaptations of Stay Strong, Stay Healthy were needed to meet the mission and values of VCE. Members of the IRPP proposed to incorporate behavior change strategies of Activity for the Ages [21], fruit and vegetable consumption component, and self-monitoring for aerobic activity outside of the strength-training sessions. The resultant program was called Lifelong Improvements through Fitness Together (LIFT) [20]. More information about the process and the Adaptome-based [28] changes of SSSH to LIFT are reported elsewhere [20] however, these adaptations are also summarized in Table 1.

Table 1. Intervention descriptions. Similarities and differences (adaptations made) between Stay Strong, Stay Healthy (SSSH) and Lifelong Improvements through Fitness Together (LIFT).

Component of Intervention	SSSH	LIFT
Duration	1-h sessions Participants encouraged to attend 2 times a week for 8 weeks	1-h sessions Participants encouraged to attend 2 times a week for 8 weeks Participants are encouraged to complete an additional thirty minutes of aerobic exercise outside of LIFT (e.g., walking, gardening, etc.)
Audience	Inactive, aging men and women	Same as SSSH
Audience	Inactive, aging men and women	
Behavior change components	Not applicable	Observational learning Self-monitoring Self efficacy Group dynamics Relapse prevention Goal setting
Exercises	Active warm-up 8 core strength-training exercises Cool down	Same as SSSH
Exercises		
Group Dynamics	Not applicable	Group environment (e.g., small groups for interaction, group name) Group structure (e.g., group roles, group norms) Group processes (e.g., friendly competition, social support, group goal setting, etc.)
Goal	Increase muscle and bone density Decrease osteoporosis and frailty	Increase muscle and bone density Decrease osteoporosis and frailty Implement group dynamics-based behavior change strategies to increase program adherence and improve functional fitness of older adults

Interventions

LIFT and SSSH were intended for older (≤65), sedentary men and women and delivered by Extension county-based health educators two times per week for eight weeks, totaling 16

sessions. Each session was designed to last an hour and consisted of strength-training, balance, and flexibility exercises that equaled eight total exercises. The exercises were as follows: wide-leg squat, standing leg curl, seated knee extension, side hip raise, biceps curl, overhead press, seated row, and toe stand. All sessions began with an active warm-up, followed by the eight exercises, and finished with a cool-down. The cool-down stretches were as follows: a hamstring and calf stretch, chest and arm stretch, and an upper backstretch. The exercise structure and contact time for LIFT and SSSH were the same. The health educators implemented behavior change strategies for LIFT participants during the entire program but particularly during warm up and cool down (see Appendix D for the session-by-session guide of behavior change strategies and example activities). For example, during the warm up of session 4, there was discussion of motivators and barriers of physical activity and within the cool down of session 5, participants were encouraged to set goals for the following week.

Research Design

This study was a pragmatic, randomized controlled feasibility trial. Health educators of VCE (N = 52) were invited to attend in-person training on physical activity promotion interventions. The physical activity training was hosted by the lead and senior authors and included training on (1) the primary evidence-based principles of obtaining physical activity behavior change, (2) strength-training exercises (proper form, cues to deliver, safe speed, etc.), (3) the importance of evaluation tools (surveys, functional fitness assessment, and demographic information, and (4) personal experience and experiential practice in leading groups through strength-training exercises (all training materials are available upon request).

Before a full launch of LIFT across the state of Virginia, it was essential to test the feasibility of the adaptations and build the evidence-base of the program. Health educators who

attended the 2015 training and were still interested in translating LIFT into their communities (*n* = 13) were invited to attend a three-hour, in-person information session in January of 2016. Specific to the January 2016 training, health educators were (1) re-familiarized with the adapted program, LIFT and (2) given repeat demonstrations of the eight strength-training exercises and functional fitness assessments. Following the training, nine of the thirteen health educators of Extension agreed to be randomized to deliver LIFT or SSSH within their community as part of the feasibility study during the months of May through August 2016.

Older Adult Participants

Extension health educators recruited older adults (≤65) through email, community bulletin boards, newspaper articles, phone calls, etc. LIFT participants (n = 80) and SSSH participants (n = 33) were required to complete the Physical Activity Readiness Questionnaire (PAR-Q) [32]. In any case that a participant did not pass the PAR-Q (see Appendix G), they must have obtained written support from their primary care physician before participating in LIFT or SSSH (see Appendix H). All eligible individuals who agreed to participate were given a detailed description of the study, contact information of the principal investigators, and provided informed consent. Functional fitness assessments were conducted before and after the study (see Appendix C) along with a pre-program and post-program survey (see Appendix E). Participants were encouraged to attend all 16 sessions.

All study procedures were completed in accordance with the approval of the Virginia Tech Institutional Review Board (#16-032). Health educators and older adults provided written informed consent prior to participation in this study. Participation in this study was voluntary and all data were kept confidential.

Measures

Reach, Representativeness, and Retention

The pre-program survey assessed self-report, socio-demographics to gather data regarding the reach, or number, proportion, and representativeness of LIFT participants [33]. Reach data were calculated as a proportion of the total eligible population (inactive adults ages 65 and older in the state of Virginia based on the United States Census Bureau-Virginia) and the total sample enrolled in LIFT. Representativeness, or the degree to which the sample reflected the target population, was calculated based on the total eligible population for important demographic characteristics such as sex, race, and ethnicity.

Attendance was also recorded at the beginning of each program session to assess overall retention rate, or the proportion of participants who were present at follow-up. Present at follow-up was given a dichotomous variable (1 = completed and therefore retained, 0 = incomplete and therefore not retained) based on the participants' completion of post-program survey or a post-program functional fitness test.

Cohesion

The Physical Activity Group Environment Questionnaire (PAGE-Q) was previously validated in a group-based program for older adults to determine individuals' perceptions of task and social integration as a measure of group cohesion [34]. There are four dimensions of cohesion: an individuals' attraction to the group's task (ATG-T), an individuals' attraction to the group socially (ATG-S), the unity of the group around a task (i.e., exercise) (GI-T), and the unity of the group socially (GI-S) [35]. Individuals' attractions to the group were assessed using items such as "I like the amount of physical activity I get in this program" (ATG-T) and "my group is an important social outlet for me" (ATG-S). The dimensions for group integration were assessed using items such as "our group works together to achieve our physical activity goals" (GI-T) and

"our group spends time socializing with each other" (GI-S). For the purposes of this trial, three additional constructs were included to assess friendly competition, (e.g., "there is friendly competition within our group to stay as healthy as possible"), cooperation (e.g., "we all cooperate to help the program run smoothly"), and task- and social-based communication (e.g., "our group discusses the importance of regular physical activity" (task) and "people in my group talk about things that are happening in our lives" (social).. These additional measures were previously tested in a group dynamics program for racial and ethnic minority women [36].

There are three items associated with each construct with the exception of task-based communication. An additional item for task communication was added to address strength-training specifically ("members of our group talk about how often they should do strength-training"). A 5-point Likert scale was used, in which 1 = strongly disagree, 3 = neither agree nor disagree, and 5 = strongly agree.

Effectiveness

The previously validated and reliable functional fitness test by Rikli and Jones [6] was used to measure functional fitness outcomes of all participants. The functional fitness test measures upper and lower body strength, aerobic endurance, upper and lower body flexibility, and agility/dynamic balance [6]. For ease of administering the test, the 2-min step-test was used to measure aerobic endurance in place of the 6-min walk. The pre-program functional fitness test was conducted to establish a base-line physical activity assessment for each participant, while the post-program functional fitness test was conducted to determine maintenance or any changes in functional fitness capabilities following the 8-week strength-training (LIFT or SSSH) program. The health educator for each cohort obtained the functional fitness assessments. Practitioners collected data, as it is more reflective of what would happen in practice to obtain outcome data.

Secondly, the same health educator conducted assessments at pre- and post- measurement time points to ensure consistency.

To evaluate balance, a graded balance test [27] was done in conjunction with the pre- and post- functional fitness test. This assessment consists of six balance movements, each held for 10 s. If at any point a participant could not hold a position for 10 s, they did not move on to attempt the next balance movement. An overall composite balance score was calculated based on the number of balance movements the participants were able to complete. The graded balance test was used to be consistent with the SSSH protocol [27]. Going forward, a more widely used tool that has shown to be valid and reliable, the Berg Balance scale, will be used to assess older adult balance [37].

System-Level Indicators

While not the primary purpose of this paper, adoption rate and system-level maintenance were also captured. Adoption data were operationalized as the proportion of eligible and interested health educators who agreed to deliver LIFT or SSSH as part of the feasibility study [20]. System-level maintenance data were operationalized as health educators' intent to deliver the program in the future (1 = intend to deliver; 0 = do not intend to deliver) [20].

Statistical Analyses

Statistical analyses were performed using statistical analysis software (SPSS version 23.0 for Windows, IBM Corporation, Armonk, NY, USA). Conventional descriptive statistics were used to describe the demographics of LIFT and SSSH participants. Inferential statistics (chi-square tests) were used to estimate (due to sample size differences) if representativeness of the program was different from the target population. These methods were adapted from a previous peer-reviewed, older adult physical activity study [38]. Retention rate was reported as a

percentage of participants who completed either a post-program functional fitness assessment or survey and those who did not complete either the post-program functional fitness assessment or survey.

Repeated measures analysis of variance (ANOVA) were used to evaluate between-group differences at baseline and post-program with respect to the validated Rikli and Jones functional fitness test [6] and the Physical Activity Group Environment Questionnaire [34]. Inferential statistics (*t*-tests) were used to detect within group differences between pre- and post-functional fitness tests and PAGE-Q measures. Baseline PAGE-Q analyses included individuals who completed a pre-program survey and post-program analyses included individuals who were present at follow-up. Statistically significant differences were determined at a level of $p \leq 0.05$.

Chi-squared analyses were used to detect significant differences between pre- and post-balance measures of those that completed each balance movement. Statistically significant differences were determined at a level of $p \leq 0.05$.

Results

Reach, Representativeness, and Retention

For the feasibility trial, four of the thirteen (31%) eligible health educators delivered LIFT to five cohorts of participants (one health educator delivered LIFT to two cohorts) and two (15%) eligible health educators delivered SSSH to two cohorts of participants. Health educators who delivered LIFT were able to reach a total of 80 older adult participants with an average starting class size of 20 (±11) individuals whereas those who delivered SSSH were able to reach 33 older adult participants with an average class size of 16.5 (±6) individuals (see Figure 1).

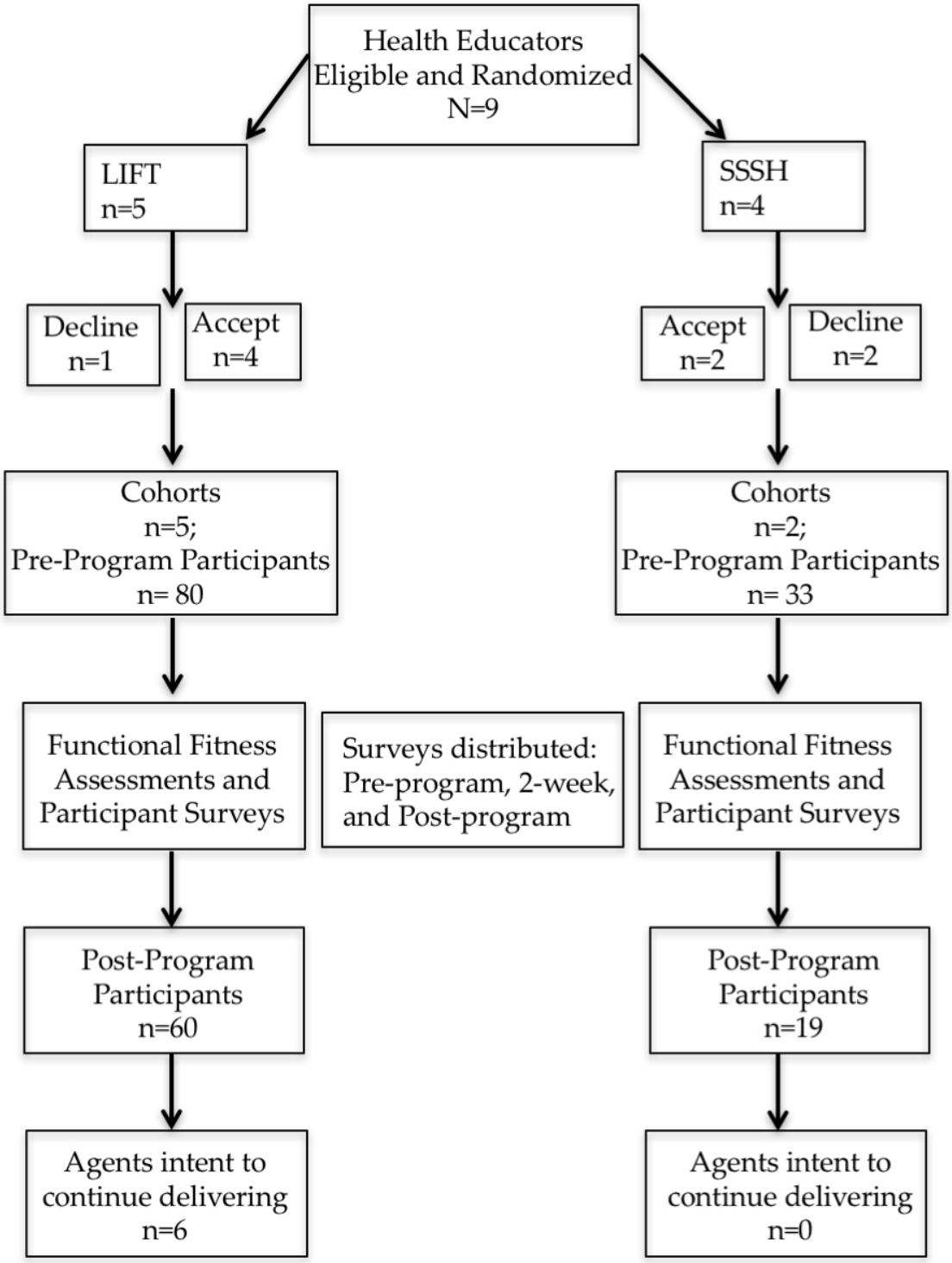

Figure 1. CONSORT diagram of the feasibility study design and outcomes based on the number of health educators who delivered LIFT or SSSH, the number of participants reached, assessment of functional fitness, participant retention rates, and number of health educators planning to deliver LIFT or SSSH in the future.

Although the overall reach was significantly smaller compared to the number of eligible participants in the state of Virginia, our sample was representative of the total eligible population to participate based on ethnicity and race (see Table 2). However, the percentage of male participants in LIFT and SSSH was significantly smaller when compared to the overall eligible male population. However, SSSH was not representative in aspects of race ($p < 0.01$) and ethnicity ($p < 0.01$). Although not significantly different ($p = 0.138$), retention rates trended in the hypothesized direction in that LIFT retained 75% of the participants and SSSH retained 58% of the participants.

Table 2. Demographic information of total eligible population in Virginia (based on available census data) and demographic information of the sample participants enrolled in LIFT and SSSH.

Characteristics	Population [a] (N = 1,019,857.52)	LIFT (n = 80)	SSSH (n = 33)
Age, *M* (SD)	65+	72.55 (±11.06)	73.63 (±9.68)
BMI, *M* (SD)	27.8	30.56 (±6.23)	33.77 (±8.11)
Sex, %			
Male	44	14 *	9 *
Female	56	73 *	73 *
Not reported	-	13	18
Ethnicity, %			
Hispanic	3	3	0 *
Non-Hispanic	97	78	82 *
Not reported	-	19	18
Race, %			
White	79	56	27 *
Black	15	11	52 *
Other	6	1	3 *
Not reported	-	12	21

[a] Data obtained from United States Census Bureau: Virginia. Inferential statistics (chi-squared tests) were used to determine significant differences between the representativeness of the total eligible population in Virginia compared to the total sample population of LIFT and SSSH (* $p < 0.05$ and represents differences between the interventions compared to the whole population).

Cohesion:

Due to differences in response rate, change scores from baseline to post-program are not reported. However, repeated measures ANOVA describe no significant differences in perceptions of cohesion between intervention groups over time ($p < 0.05$).

Table 3. Pre- and post-program Physical Activity Group Environment Questionnaire (PAGE-Q) change scores on a 5-point Likert scale, by intervention.

Group Cohesion Dimension	Intervention	*n*	Baseline	*n*	Post Program	Between Group Differences
Attraction to group: Task	LIFT	65	4.36 (±0.60)	40	4.38 (±0.72)	0.551
	SSSH	22	4.61 (±0.47)	17	4.51 (±0.99)	
Attraction to group: Social	LIFT	65	3.67 (±0.81)	40	3.81(±0.84)	0.881
	SSSH	21	4.51 (±0.61)	17	4.24 (±1.04)	
Group integration: Task	LIFT	65	3.89 (±0.63)	39	4.0 (±0.80)	0.179
	SSSH	22	4.58 (±0.51)	17	4.06 (±1.09)	
Group integration: Social	LIFT	65	3.14 (±0.88)	35	3.28 (±0.80)	0.845
	SSSH	20	4.24 (±0.83)	17	3.84 (±1.12)	
Cooperation	LIFT	64	4.17 (±0.56)	36	4.09 (±0.77)	0.806
	SSSH	21	4.38 (±0.60)	18	4.20 (±1.02)	
Friendly Competition	LIFT	64	3.70 (±0.72)	35	3.53 (±0.86)	0.825
	SSSH	22	4.38(±0.73)	17	4.16 (±1.02)	
Communication: Task	LIFT	64	3.68 (±0.80)	35	3.60 (±0.87)	0.861
	SSSH	22	4.14 (±0.71)	17	4.0 (±1.05)	
Communication: Social	LIFT	64	3.62 (±0.76)	35	3.74 (± 0.77)	0.884
	SSSH	22	4.29 (±0.75)	17	4.04 (±1.05)	

n: the number of participants who responded to the survey and were included in the analyses (* $p < 0.05$).

Effectiveness: Functional Fitness and Balance Tests

Results of ANOVA showed there were no significant differences when comparing LIFT to SSSH participants for six of the seven functional fitness assessments. However, LIFT was superior to SSSH in regard to participants improving in the 2-minute step test score ($p = 0.02$) (Table 4). T-test analyses showed that LIFT participants were able to significantly improve in all seven functional fitness measures whereas SSSH participants only significantly improved in 5 of

the 7 measures. For example, LIFT participants completed significantly ($p < 0.05$) more arm curls in 30 seconds (3.65 ± 6.03 versus 1.40 ± 6.37 arm curls) and significantly reduced their 8-foot-up-and-go time (–0.65 ± 1.31 s versus –0.06 ± 1.97 s) where SSSH participants did not (Table 4). Functional fitness change scores (from baseline to post-program) were similar within groups for the 30-second sit and stands, 2-minute step test, lower and upper body flexibility, and the overall balance scores (see Table 4).

Table 4. Pre- and post-program functional fitness change scores and composite balance change scores, by intervention.

Functional Fitness Assessment, *M* (SD)	Intervention	Baseline	Post-Program (ITT) [a]	Change Scores	Between Group Differences
Sit and stands [b]	LIFT	10.58 (±3.21)	13.07 (±5.14)	2.49 (±3.73) *	0.19
	SSSH	9.40 (±4.29)	10.71 (±3.22)	1.31 (±2.17) *	
Arm curls [b]	LIFT	13.89 (±4.0)	17.65(±6.22)	3.76 (±6.03) *	0.57
	SSSH	14.50 (±5.55)	15.9 (±4.3)	1.40 (±6.37)	
2-min step test [c]	LIFT	61.66 (±30.0)	77.5 (±30.0)	15.84 (±16.71) *	0.02
	SSSH	52.6 (±22.6)	72.4 (±32.3)	19.8 (±33.09) *	
Lower body flexibility [d]	LIFT	–1.74 (±3.86)	–0.03 (±2.96)	1.71 (±2.97) *	0.95
	SSSH	–0.76 (±3.12)	0.68 (±3.05)	1.44 (±2.53) *	
Upper body flexibility [d]	LIFT	–5.05 (±4.93)	–4.2 (±5.51)	0.85 (±3.17) *	0.67
	SSSH	–6.05 (±5.69)	–4.8 (±4.06)	1.25 (±1.94) *	
8-foot up-and-go [e]	LIFT	7.68 (±3.84)	7.02 (±3.25)	–0.66 (±1.31) *	0.73
	SSSH	7.19(±2.92)	6.6 (±1.94)	–0.59 (±1.97)	
Composite balance [f]	LIFT	2.44 (±1.3)	2.79 (±1.5)	0.35 (±1.18) *	0.78
	SSSH	2.00 (±1.0)	2.42 (±1.4)	0.42 (±0.99) *	

[a] ITT: Intention to Treat: A participant's baseline score was included in the ITT analysis if they were not present for the post-program functional fitness assessment but did respond to the post-program survey. [b] Repetitions completed in 30 seconds; [c] Number of steps taken in 2 minutes; [d] Flexibility reported in inches; [e] Time (in seconds); [f] Total number of balance moves completed out of six. Paired *t*-test determined significant differences within program from baseline to post-program (ITT) (* $p < 0.05$).

System-Level Indicators

Of the 13 health educators who expressed interest in the feasibility study, 9 (70%) agreed to be randomized to deliver LIFT or SSSH. Of the nine who agreed to be randomized, five health educators were randomized to LIFT and four (80%) delivered or adopted within their community. Four health educators were randomized to SSSH and two (50%) adopted the program within their community [20].

One hundred percent of the health educators who delivered LIFT reported that they had intentions to deliver LIFT in the future. Of those who delivered SSSH, 0% confirmed their intentions to deliver SSSH in the future. However, the two health educators (100%) who

delivered SSSH indicated their intention to deliver LIFT in the future. The health educators who delivered SSSH expressed their desire to incorporate the nutrition component and active facilitation of the social environment for their older adult participants [20].

Discussion

The primary purpose of this study was to determine the reach and effect (i.e., functional fitness) of an evidence-informed program that was adapted through an IRPP. This study reports a pragmatic approach for an evidence-based, health educator-led program, LIFT, to reach inactive older adults. Results of the study indicate that participation in an 8-week strength-training program can significantly improve the strength, flexibility, agility, dynamic balance, and aerobic endurance of older adults. These improvements in functional fitness enable older adults to live independently longer and more safely [39]. Although not significant, the group-based program, LIFT, had greater retention rates as well as delivery personnel intent to continue delivery.

There were more participants in the LIFT intervention arm when compared to the SSSH intervention arm. Although there were fewer health educators delivering SSSH, there were also less participants per health educator (20 participants per health educator in LIFT versus 16 per health educator in SSSH). Although the overall sample size may seem small compared to the overall older adult population in Virginia, the reach of LIFT was comparable to other physical activity interventions [40] and strength-training interventions [5]. With the exception of male versus female participants in the LIFT intervention arm, the data provide evidence that delivery through Extension was successful at reaching a representative sample of the overall target population. However, SSSH was not representative of the population in regard to race and ethnicity, which can be attributable to the geographical location that the SSSH intervention was delivered. Future recruitment efforts should aim to recruit more male participants. This may

result in a strength-training program that has a more generalizable public health impact on physical activity behaviors of older adults.

In addition to concerns for reach and representativeness, the LIFT program was developed to specifically retain more people throughout the program. To align with this mission, LIFT was developed as a group dynamics-based intervention [21, 41-43]. Group-based interventions have previously improved retention rates within exercise interventions [44, 45] and the retention rate of LIFT was similar to other studies that reported on retention rates (~70%) [46, 47]. Notably, the group dynamics literature has called for mediation analyses [48-50]. Specific to this study, full mediation [51] were not conducted as the first assumption was not met (i.e., retention within LIFT was not significantly greater than SSSH). Although there were no significant differences in perceptions of cohesion between SSSH and LIFT, participants in both interventions initially reported high (≥3: neither agree nor disagree on the Likert scale) perceptions of group cohesion at baseline, leaving little room for improvement at the end of the sessions. High perceptions of group cohesion at baseline may have been a result of the participants being recruited from the same communities. Another limitation of this analysis was that there were very few participants who completed the PAGE-Q during the post-program survey.

The results of this study also indicated that older adult participants were able to significantly improve their functional fitness for strength, flexibility, aerobic endurance, agility, and dynamic balance. This evidence should not be surprising, as the literature suggests consistent participation in a strength-training program increases overall physical activity of older adult individuals [52]. However, many physical activity programs do not presently incorporate evidence-based behavior change strategies (e.g., goal-setting, group dynamics-based activities,

and self-monitoring) [53-55]. Existing strength-training intervention studies have shown positive effects for individuals with improvements in strength, physical function, mobility, chronic illnesses, and most recently, a decrease in all-cause mortality [7, 56, 57]. However, the heterogeneous measures across these strength-training studies (e.g., self-report, direct observation, objective) leaves paucity in the literature with regard to improvements in functional fitness [29]. Therefore, future studies that objectively measure the outcomes of functional fitness for older adults are imperative.

This study also provided preliminary support that a theory-based intervention with behavior change strategies embedded within an exercise program did not compromise the effectiveness of the functional fitness assessments and although not significantly different, had improved retention rates at the end of the intervention. Further related, although self-report leisure-time physical activity was not assessed during this trial, three of the four health educators who delivered LIFT reported that their participants were either, a) inquiring about an advanced version of LIFT to participate in in the future, b) were hoping to join another cohort of LIFT at the end of the first eight weeks, and c) were continuing to meet at the end of eight weeks to continue the exercise routine one time weekly. Although these data are not measurable, they provide support that LIFT was able to impact physical activity behaviors, of a sup-sample of participants, beyond the length of the intervention. Future research, which is underway, is needed to explore long-term physical activity behaviors of older adults who have engaged in a strength-training program that targets behavioral change strategies (e.g., goal-setting, self-monitoring, self-efficacy, etc.).

This study did not come without limitations. First, there was a small sample size of health educators delivering LIFT to older adults. Our sample size can be justified as this was a pilot

implementation study to ensure that LIFT was feasible and could be delivered as intended [20] within this community-based setting while improving the reach and effect for older adults. Twenty years of existing evidence supports the use of strength-training interventions to reach older adults and improve their physical activity behaviors [58] however, there is a dearth of transparent reporting on local-level adaptations and implementation to capture how adaptations may negatively or positively influence the effect of an intervention [28]. Second, health educators were not blind to randomization. This method for randomization was chosen as county-based health educators in the LIFT program needed to deliver the fruit/vegetable consumption portion and behavior change strategies whereas the SSSH health educators needed to adhere to the SSSH protocol. Results of this disappointment left potential for program drift [28]. Third, we were unable to gather sufficient 6-month, self-report physical activity follow-up data. Future studies should aim to collect follow-up data on physical activity behavior to ensure these interventions are resulting in long-term physical activity behavior change for older adults.

Taken together, LIFT improved all measures of functional fitness for older adults and retained those older adults throughout the entire intervention. Although literature supports the effectiveness of strength-training interventions for older adults [11, 59] it was necessary to conduct the feasibility trial to ensure that state-wide dissemination of LIFT would be evidence-based, not evidence-informed.

Conclusions

Delivery of LIFT by Extension health educators had significant reach, representativeness, and improved effect for previously sedentary older adult participants. It is important to note that the four health educators who delivered LIFT and both health educators who delivered SSSH expressed their desire to continue or begin delivery of LIFT in the future. As the number of

health educators delivering LIFT continues to increase, a greater number of older adult participants will be recruited to participate in LIFT. Reaching a greater proportion of the target population will result in an intervention that has a greater public health impact on the sedentary behaviors and functional fitness of older adults. To conclude, offering an open-access [60] community- and group dynamics-based strength-training intervention to older adults can successfully improve the reach and representativeness of an intervention while improving the functional fitness of older adults. These improvements may result in long-term physical activity behavior change of older adults, which may ultimately lead to older adults living independently longer (maintaining autonomy, free of chronic disease, etc.).

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Manuscript 3

Determining the Feasibility, Acceptability, and Appropriateness of Lifelong Improvements through Fitness Together (LIFT) in a Nonprofit Health Care Setting

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Abstract

Older adults remain one of the most inactive subgroups of individuals despite the many benefits of physical activity. To improve the rate at which older adults engage in physical activity, health care providers can refer older adult patients to community-based physical activity interventions. Patients view their health care providers as credible sources of health and wellness information and are more likely to engage in physical activity if it is recommended or suggested by their healthcare provider. Unfortunately, health care providers are often unaware of existing community-based physical activity interventions for referral. One approach to link health care providers and surrounding stakeholders is through an integrated research-practice partnership (IRPP). Forming a partnership with key stakeholders to identify potential programs may influence program uptake and sustainability if the intervention 'fits' within the intended delivery setting. Therefore, the purpose of this work was to describe the development, processes, and temporal outcomes of a participatory approach using the RE-AIM framework to plan and evaluate the translation of an evidence-based intervention (Lifelong Improvements through Fitness Together or LIFT) into a nonprofit health care setting. Prior to implementing LIFT referral, members of the partnership used a validated scale for feasibility, acceptability, and appropriateness to determine care coordinator and physician perceptions of referring to LIFT as well as potential barriers of the LIFT referral scheme, and, for care coordinators only, willingness to pilot test the referral scheme. Of the 78 care coordinators and approximately 270 physicians who received the surveys, 58 (74%) care coordinators and 39 (~14%) physicians responded, respectively. Overall, care coordinators perceived LIFT referral as feasible (3.75 ± 0.86), acceptable (3.93 ± 0.83), and appropriate (3.8 ± 0.87) while physician's perceived LIFT referral as feasible (4.00 ± 0.81), acceptable (4.26 ± 0.64), and appropriate (4.27 ± 0.62) on a 5-

point Likert scale. Thirty-two (55%) of the 58 care coordinators reported being interested in pilot testing LIFT referrals within their practice. The three most commonly reported barriers by care coordinators were cost, transportation, and location and similarly, the three most commonly reported barriers from physicians were cost, transportation, and patient buy-in. In conclusion, results of this study indicate that working through an IRPP to gather opinions of prospective adopters as a method to assess intervention 'fit' within a practice setting prior to implementation. Future work is needed to explore the uptake and impact of the LIFT referral scheme within this system.

Introduction

Being physically active is an effective way to reduce older adults' risk of falls, prevent or delay the onset of chronic diseases, increase muscle strength, maintain healthy bones, and reduce all-cause mortality [1, 2]. Evidence-based physical activity interventions have the potential to be prescribed by health care providers within a clinical setting [3] and delivered within a community setting [4-6]. Approximately 83% of older adult patients have contact with a health care provider at least once annually [7]. Patients view their health care providers as credible sources of health and wellness information and are more likely to engage in physical activity if it is recommended or suggested by their health care provider [8].

There are a number of approaches health care providers can use to promote physical activity. Promotion of physical activity can be accomplished through assessment of physical activity behaviors [4], verbal counseling [9, 10], written exercise prescriptions [11], or referrals to clinical or community exercise programs [12]. These strategies of physical activity promotion and referral in clinical settings have been effective but are often underutilized by health care providers [13]. Reasons attributed to low uptake of these practices include: lack of awareness that community-based interventions exist or organizational barriers such as a lack of reimbursement for efforts, lack of enforcement of the practice, or lack of clinical-community linkages [14].

One community-based system that clinicians can link to is the National Cooperative Extension System. The National Cooperative Extension System (herein: Extension) was initially developed as a collaboration between local and federal governments, agricultural researchers at land grant universities, and farmers [15]. Community-based Extension professionals brought university-developed information to local farmers and, in doing so, developed trusting

relationships. This knowledge-sharing and relationship building sped the adoption and implementation of agricultural innovations [16]. Borrowing from success in agriculture, the same model can be applied to link universities, clinics, and patients in the community [16]. To date, there is limited evidence around successful integration of clinical-community referral strategies (specific to Extension) [17] despite the known benefits of promoting physical activity for overall health [18].

One way to increase health care provider awareness and utilization of Extension programming is to use a participatory approach. Participatory research acknowledges the importance of involving the targeted community members as well as key stakeholders to improve the quality, relevance, and benefits of research within the intended setting [19]. This approach may vary in the degree of partnership between researchers and stakeholders [20]; however, the overall aim is to collaboratively identify a need and accomplish change within the setting to satisfy the need [19].

As an example, and specific to physical activity, the Move More! trial was developed, delivered, and evaluated through an IRPP between researchers and stakeholders of Kaiser Permanente (e.g., a not-for-profit health care system) [21]. The intervention was able to reach a large proportion of the target population, had sustained effects for improving physical activity behaviors beyond the length of the intervention, and resulted in sustained implementation beyond the scope of the research study because it did not interfere with the standard care practices of the health care providers [21].

Another example of a physical activity program that was developed through a Community-based Participatory Research (CBPR) approach was an adapted version of Choose to Move, which promoted physical activity for women [22]. As a result of tailoring the program

with and for the target community, the program attracted a large number of women who saw significant improvements in both moderate and vigorous physical activity levels over eight weeks. Employing the participatory approach and building a physical activity program to meet the existing community infrastructure shows promise for sustainability over time [22].

While work to link academic settings to clinical settings or academic settings to Extension settings or clinical settings to Extension settings exists, there are as few as five known successful partnerships that link all three: academic-, clinical-, and Extension-settings [16]. From these five studies, it is evident that this type of partnership resulted in sustained relationships and improved patient health care outcomes [16]. Formation of an academic-, clinical-, and Extension partnership enables researchers to transfer evidence-based knowledge to clinicians and Extension stakeholders for their use in practice settings [16]. Taken together, employing a collaborative approach between health care systems, Extension stakeholders, and academic entities aims to ensure that, a) the research interests align with the delivery settings' needs and mission, b) the intervention will reach a greater number of the target population, c) results will be sustainable and generalizable for the target population, and d) the intervention will be implemented with fidelity to warrant a significant public health impact [23-25].

One way to evaluate these aims is to employ the RE-AIM (**R**each, **E**ffectiveness, **A**doption, **I**mplementation, **M**aintenance) framework. RE-AIM was developed to help balance internal and external validity of developing interventions by placing emphasis on factors that are not controlled in practice settings [26]. It has since been used as an organizational tool for researchers to plan *and* evaluate the potential and anticipated translational outcomes and intervention sustainability prior to intervention development and adoption [27]. Use of this framework allows researchers to report upon who, what, when, where, why, and how the

intervention was 'intended' *and* the 'actual' who, what, when, where, why, and how the intervention was received [28]. Understanding the potential for translation prior to implementation may improve the link between the researcher- clinical- and Extension continuum [27, 28].

Finally, while participatory approaches are touted for their ability to reduce the translational lag time [29], engaging in this type of research takes adequate time to form relationships with stakeholders, build trust, identify a need specific to each setting, develop interventions that address the need and are suitable for the delivery setting, and produce desirable outcomes [25]. However, empirical evidence regarding reduction of lag time for integrating evidence into practice-based settings specific to physical activity outcomes for older adults does not exist. The long-term nature of partnership development may lead to unanticipated (positive or negative) and *unplanned* outcomes (e.g. stakeholder turnover, funding issues, shifts in priority, setting-level structural changes, etc.) [30], that can be illustrated through the use of the RE-AIM planning *and* evaluation framework [28].

Therefore, the purpose of this paper was to describe the development, processes, and *temporal* outcomes of a participatory approach linking stakeholders across the academic-clinical-Extension continuum. This work was planned and evaluated through the RE-AIM framework. Primary outcomes were related to the feasibility, acceptability, and appropriateness of bringing an evidence-based intervention (Lifelong Improvements through Fitness Together) [31] to a nonprofit health care setting.

Methods

Intervention Setting

Carilion Clinic is a nonprofit health care system and serves four regions of Virginia; 1) Roanoke Central and South, 2) New River Valley (NRV) East, 3) NRV West, and 4) Shenandoah Valley. The health care system is based out of Roanoke, VA, spans 250 square miles, and serves 345,442 patients, of which, 93,609 (27%) are 65 and older. The mission of Carilion Clinic is to "improve the health of the communities we serve." Similarly, Virginia Extension has a mission to "build local relationships and collaborative partnerships, we help people put scientific knowledge to work through learning experiences that improve economic, environmental, and social well-being." The Physical Activity Research and Community Implementation (PARCI) Lab mission is to "bridge clinical referral and community-based programming for healthy lifestyle interventions." Taken together, these academic-clinical-Extension entities share an interest in health promotion for aging adults.

Specific to physical activity promotion for older adults, there are a number of evidence-based programs registered (e.g., Research-Tested Intervention Programs [RTIPs], Go4Life, etc.). However, there are a limited number of open access programs for aging adults [32]; that is, programs that are available for any aging adult, rather than those with a specific pre-existing conditions [32]. Many evidence-based physical activity promotion programs for aging adults are only available, for example, in cardiac rehabilitation and diabetes prevention, to name only a few. Extension offers a healthy lifestyle program for aging adults without an existing health condition. Therefore, an IRPP approach was used to determine initial perceptions for the potential translation of an open-access, physical activity *and* healthy lifestyle program for older adults to bridge the gap between Extension and clinic settings.

Strategy Selection

In February of 2017, the Chair of Family and Community Medicine, the Project Consultant and Research Coordinator of Family and Community Medicine, and the Exercise Specialist of Virginia Extension met to discuss the need for a healthy lifestyle intervention for aging adults. The Exercise Specialist shared the potential for translating Lifelong Improvements through Fitness Together (LIFT) program into the Carilion Clinic health care system. LIFT is an eight-week, group dynamics-based program delivered by county-based health educators of Extension for aging adults, which focuses on functional fitness (or the ability to perform activities of daily living with ease), nutrition, and healthy lifestyle habits outside of the program. Based on pilot testing within Extension, LIFT was able to significantly improve the functional fitness outcomes for aging adults [31]. As a partnership, it was then decided that LIFT would be the program of choice for health care providers to prescribe to their aging patients via a referral to their local county-based health educator as the delivery personnel for LIFT. In March 2017, a 3rd year PhD student and a 2nd year medical student joined the partnership.

During the initial IRPP meeting, members of the partnership established a protocol and timeline that was guided by the RE-AIM framework. During the initial planning and evaluating of LIFT within Carilion Clinic, members of the IRPP answered the following questions [28] (see Table 1): 1) Who was intended to benefit from the intervention (reach)?, 2) What were the most important benefits to achieve (effectiveness)?, 3) Where would LIFT be applied (adoption)?, 4) How to adapt LIFT to fit the needs of the setting (implementation)?, 5) How long will the program be sustained (system-level maintenance)?, and 6) How will LIFT impact health outcomes (participant-level maintenance)? The IRPP agreed to work in close collaboration to efficiently pilot test LIFT referral by health care providers in Carilion Clinic to Extension health educators within the community. The primary effectiveness outcomes for the Family and

Community Medicine and PARCI Lab stakeholders were improvements in functional fitness and reduction in diabetes related outcomes (A1c levels) for aging adults.

Strategy Adaptations: Care Coordinators as Targeted Referral Agents

Initially, the intent of translating LIFT to Carilion Clinic was through use of a physician-only referral system because Family and Community Medicine physicians of Carilion Clinic meet with approximately 18-25 patients per day and have direct access with patients in need of LIFT. It was decided that Carilion Clinic care coordinators and medical office assistants would be a more appropriate point of referral due to their contact with patients and familiarity with local interventions. Care coordinators meet with approximately six patients per day for 30-45 minutes to discuss goal setting, disease management, and healthy lifestyle-based programming whereas medical office assistants process referrals for patients or engage in skilled nursing. Care coordinators and medical office assistants can potentially represent multiple practices across one or more regions of Carilion Clinic, depending on the size of each practice. Members of the IRPP sought the opinions of Family and Community Medicine physicians, care coordinators, and medical office assistants to determine their perceptions of the feasibility, acceptability, and appropriateness [35] of this approach. The Director of Family and Community Medicine of Carilion Clinic invited survey responses from physicians' via email (see Appendix I) whereas care coordinators' and medical office assistants' (herein: care coordinators) perceptions were collected at a quarterly care coordinator meeting in November of 2017 (see Appendix J). Care coordinators that represented all four regions of Carilion Clinic were in attendance.

Feasibility, acceptability, and appropriateness were chosen as the three key implementation outcomes as they have shown to be "leading indicators" of successful implementation [33]. Proctor and colleagues have defined these three implementation outcomes

as follows [34]: *Feasibility* is the extent to which a new treatment, or an innovation, can be successfully used or carried out within a given agency or setting; *Acceptability* is the perception among implementation stakeholders that a given treatment, service, practice, or innovation is agreeable, palatable, or satisfactory; *Appropriateness* is the perceived fit, relevance, or compatibility of the innovation or evidence-based practice for a given practice setting, provider, or consumer; and/or perceived fit of the innovation to address a particular issue or problem.

Negative perceptions of feasibility, acceptability, appropriateness and barriers associated with the program referral would terminate the translation of LIFT referral into Carilion Clinic. For example, 1) if referral of LIFT is not feasible, health care providers will not refer, 2) if they do not believe LIFT is appropriate for their patients, health care providers will not refer, and 3) if it is not accepted within the setting, health care providers will not refer. Therefore, garnering the opinions of those who would be adopting the practice was an essential first step strategy adaptation prior to full-scale implementation of the LIFT referral in Carilion Clinic. Not all outcomes of RE-AIM were deemed as appropriate for this work [35], and reach and adoption were the primary foci, with feasibility, acceptability, and appropriateness as predictors of implementation.

Measures

Reach

Care Coordinators: Reach was reported as the total proportion of eligible care coordinators that represented Carilion Clinic to those who attended the quarterly meeting. Reach was also reported as the total proportion of eligible care coordinators who attended the quarterly meeting to those who responded to the post-meeting survey, by the region of Carilion Clinic they represent.

Physicians: Reach was reported as the total proportion of eligible physicians that received the survey via email and those who responded to the survey. Reach was also reported as the total proportion of physicians, by region of Carilion Clinic, who responded to the survey.

Implementation Outcomes

An adapted version of the validated feasibility, acceptability, and appropriateness scale [34] was distributed via survey to both physicians and care coordinators. There were four items associated with each construct and a 5-point Likert scale was used for which 1= completely disagree, 3= neither agree nor disagree, and 5= completely agree. Perceptions of feasibility were assessed using items such as, "…the program seems easy to use". Perceptions of acceptability were assessed using items such as, " LIFT is appealing to me." Lastly, perceptions of appropriateness were assessed using items such as, "… the program seems applicable."

Barriers

Care coordinators were asked to respond to an open-ended prompt: "What are three barriers for referring patients to LIFT?" The lead author independently separated barrier-meaning units and determined categories and themes from these data.

Physicians were asked to respond to an open-ended prompt: "Please feel free to share any other feedback you may have at this time." The lead author independently separated barrier-meaning units and determined categories and themes from these data.

Adoption

Care coordinators: Adoption data were operationalized as care coordinators' interest in piloting LIFT referrals within their practice setting. Those data are reported as the proportion of total eligible and interested care coordinators who were present at the annual meeting and the sample collected, by the region they represent.

Physicians: Due to practice-needs for brevity of the survey, adoption data were not collected from physicians.

Statistical Analyses

Statistical analyses were performed using statistical analysis software (SPSS version 23.0 for Windows, IBM Corporation, Armonk, NY USA) with significance set at $p < 0.05$. Proportions were used to describe the reach of care coordinators and physicians in total and by region. Frequencies and descriptive statistics were used to determine overall perceptions of acceptability, appropriateness, and feasibility. The Mann-Whitney U-Test determined significant differences between physician and care coordinator perceptions of LIFT referral. Although the sample size was over thirty, the Mann-Whitney U-Test was appropriate due to the non-normative distribution of data and non-parametric variables. Proportions were used to describe Care Coordinators' interest in adoption of LIFT referral.

Results

Reach

Care coordinators: Of the 78 care coordinators that attended the annual meeting, 58 (74%) responded to the survey. A majority of the care coordinators in attendance were from the Roanoke Central and South region (n = 27, 47%) with 9 from Shenandoah Valley (16%), 5 from the NRV East (9%), and 6 from NRV West (10%). Six (10%) of the respondents did not report a region in which they represented and 5 (9%) represented multiple regions.

Physicians: Of the ~270 physicians who received the email prompt to complete the survey, 39 (~14%) responded to the survey. A majority of the physicians who responded to the email represented the Roanoke Central and South region (n= 23, 59%). Six physicians (16%)

represented Shenandoah Valley, 5 (13%) from NRV East, and 1 (3%) from NRV West. Four (10%) of the physicians did not report a region in which they represented.

Implementation Outcomes

Care coordinators perceived LIFT as feasible (3.75 ± 0.86), acceptable (3.93 ± 0.83), and appropriate (3.8 ± 0.87) on a 5-point Likert-scale (see Table 2). Care coordinators of Shenandoah Valley had the highest perceptions of feasibility of LIFT referral (4.08 ± 0.50) followed by NRV East (4.00 ± 0.61), those who represented multiple regions (3.85 ± 0.34), Roanoke Central and South (3.78 ± 0.73) and NRV West (2.75 ± 1.08). Care coordinators of Shenandoah Valley (4.25 ± 0.43) and of those who represented multiple regions (4.25 ± 0.50) had the highest perceptions of acceptability of LIFT referral, followed by NRV East (4.15 ± 0.49), Roanoke Central and South (3.93 ± 0.84), and NRV West (3.31 ± 0.60). Lastly, care coordinators of Shenandoah Valley also had highest perceptions of the appropriateness of LIFT referral (4.17 ±0.50), followed by those who represented multiple regions (4.00 ± 0.00), NRV East (3.90 ± 0.80), Roanoke Central and South (3.88 ± 0.79), and NRV West (2.96 ± 1.03).

Table 1. Summary of key implementation outcome variables, care coordinator perceptions of LIFT referral

Total Respondents of Care Coordinators from Quarterly Meeting	n (%) 58 (74)
Carilion Clinic Region	n (%)
Shenandoah Valley	9 (16)
NRV East	5 (09)
NRV West	6 (10)
Roanoke Central and South	27 (47)
Region not reported	6 (10)
Represents multiple regions	5 (9)

Overall perceptions that LIFT is acceptable	n (%)
Completely Agree	12 (21)
Agree	36 (62)
Neither Disagree nor Agree	6 (10)
Disagree	1 (2)
Completely Disagree	2 (4)
Overall perceptions of LIFT acceptability, 5 pt scale, *M* (SD)	3.93 (± 0.83)
Overall perceptions that LIFT is appropriate	n (%)
Completely Agree	9 (16)
Agree	38 (65)
Neither Disagree nor Agree	8 (14)
Disagree	0 (0)
Completely Disagree	3 (5)
Overall perceptions of LIFT appropriateness, 5 pt scale, *M* (SD)	3.8 (± 0.87)
Overall perceptions that LIFT is feasible	n (%)
Completely Agree	9 (16)
Agree	35 (60)
Neither Disagree nor Agree	8 (14)
Disagree	2 (3)
Completely Disagree	2 (3)
Overall perceptions of LIFT feasibility, 5 pt scale, *M* (SD)	3.75 (± 0.86)

Physicians perceived LIFT as feasible (4.00 ± 0.81), acceptable (4.26 ± 0.64), and appropriate (4.27 ± 0.62) on a 5-point Likert-scale (see Table 3). Physician perceptions are reported in aggregate (rather than by region) due to only having one response from NRV West.

Table 2. Summary of key implementation outcome variables, physician perceptions of LIFT referral

Total Respondent's of Physicians from Email Survey	n (%)
	39 (14)
Carilion Clinic Region	n (%)
Shenandoah Valley	6 (16)
NRV East	5 (13)
NRV West	1 (3)

Roanoke Central and South	23 (59)
Region not reported	4 (10)
Overall perceptions that LIFT is <u>acceptable</u>	n (%)
Completely Agree	14 (36)
Agree	17 (44)
Neither Disagree nor Agree	3 (8)
Disagree	0 (0)
Completely Disagree	0 (0)
Missing	5 (12)
Overall perceptions of LIFT acceptability, 5 pt scale, *M* (SD)	4.26 (<u>+</u> 0.64)
Overall perceptions that LIFT is <u>appropriate</u>	n (%)
Completely Agree	15 (39)
Agree	18 (46)
Neither Disagree nor Agree	3 (8)
Disagree	0 (0)
Completely Disagree	3 (5)
Missing	3 (7)
Overall perceptions of LIFT appropriateness, 5 pt scale, *M* (SD)	4.27 (<u>+</u> 0.62)
Overall perceptions that LIFT is <u>feasible</u>	n (%)
Completely Agree	11 (28)
Agree	19 (49)
Neither Disagree nor Agree	5 (13)
Disagree	1 (3)
Completely Disagree	0 (0)
Missing	3 (7)
Overall perceptions of LIFT feasibility, 5 pt scale, *M* (SD)	4.00 (<u>+</u> 0.81)

When compared to care coordinators, physicians had significantly higher perceptions of the appropriateness of LIFT referral ($p < 0.019$), but had similar perceptions of acceptability and feasibility ($p > 0.05$).

Barriers

Of the 58 care coordinator survey respondents, 45% (n=26) listed three barriers to LIFT referral. The overall average number of barriers reported was 2.68 ±0.86. The three most

commonly reported barriers were cost of class for participants (n=35, 15%), transportation for participants (n=26, 11%), and location of class (n=10, 4%).

Of the 39 physician survey respondents, nine physicians provided additional feedback within the open-ended prompt. Of the nine responses, cost was reported as a barrier three times whereas transportation and patient buy-in were reported as a barrier twice. Other barriers listed by physicians included, similar programs already exist and system-buy in.

Adoption

Care coordinators: Of the 58 survey respondents, 32 (55%) reported being interested in pilot testing LIFT referrals within their practice. These individuals were from Roanoke Central/South (50%), Shenandoah (22%), NRV West (13%), and NRV East (13%). By region, this represents 59%, 78%, 80%, and 67% of care coordinators in attendance at the quarterly meeting from Roanoke Central/South, Shenandoah, NRV West, and NRV East, respectively.

Discussion

The primary purpose of this paper was to describe an IRPP approach to link stakeholders across academic-, clinical-, and Extension settings in order to increase physical activity behaviors of aging adults. This study provided evidence that systematic use of the RE-AIM framework to plan and evaluate the translation of an evidence-based intervention into practice settings enables members of an IRPP to transparently outline a projected timeline, report on temporal outcomes, and iteratively evaluate progress over time [28]. Results of this study provide preliminary support for working through an IRPP to gather opinions of prospective adopters as a method to assess intervention 'fit' within a practice setting prior to full-scale implementation. Both open-ended survey prompts revealed common barriers of LIFT referral but overall, care coordinators and physicians of Carilion Clinic perceived LIFT referral as feasible,

acceptable, and appropriate. As a result, care coordinators reported interest in pilot testing LIFT referral within their clinics. Unfortunately, adoption data were not collected from physicians for the scope of this study.

Building a partnership with key stakeholders of the delivery setting enables collaborated efforts towards defining a health concern, refining a solution, and implementing a practice that is deliverable within the targeted setting and suitable for the target population [36]. Together, academic-, clinical-, and Extension stakeholders were able to identify the need for a 'healthy lifestyle' intervention for aging adults, refine the 'package' of LIFT to include a referral scheme with Extension, and although outside the scope of this trial, begin implementation efforts of LIFT referral by care coordinators into Carilion Clinic. Results of this study provided evidence that assessing stakeholder perceptions of intervention fit through an IRPP approach has potential for improving the success of intervention implementation or translation into a practice-based setting.

A majority of the care coordinator and physician survey respondents represented the Roanoke Central and South region of Carilion Clinic. This was unsurprising as there are a greater number of practices housed within this region and therefore, a greater number of care coordinators and physicians. Regarding the care coordinators, the quarterly meeting was held in Roanoke and therefore the meeting location may explain why there were a greater number of Roanoke Central and South region care coordinators. Unfortunately, the only survey responses received from care coordinators were from those in attendance at the quarterly meeting. Technology-based surveys and trainings have previously shown to be effective at reaching health care providers in rural areas or disparate areas [37, 38]. Providing an online option for trainings

and surveys in the future may be an effective approach for reaching a larger proportion of care coordinators that represent other regions of Carilion Clinic.

Care coordinators and physicians reported positive perceptions of LIFT referral as a feasible, acceptable, and appropriate implementation strategy. Although there is evidence to support LIFT as an effective intervention, translating it into a practice-based setting with minimal fit lowers the chance of it being delivered with fidelity, or being delivered as intended. As a result, the intervention effectiveness for older adult physical activity behaviors and functional fitness may be compromised [33]. Assessing perceptions of these implementation outcomes is an essential first step of the implementation process that reveals potential success or failure of translating an intervention into a practice-based setting [34].

Further related, physicians reported significantly higher perceptions of LIFT appropriateness within the Carilion Clinic health care system than care coordinators. Unfortunately, these data are only supported by ~14% of the primary care providers within Carilion Clinic. It can be speculated that these responses are reflective of the percentage of health care providers who received adequate training on the importance of physical activity promotion. For example, in 2013, more than 80% of medical schools in the United States did not require medical students to take physical activity-related courses [39]. Therefore, a commonly reported barrier of physical activity promotion by health care providers is lack of education and training for physical activity counseling [40]. Although preliminary, these higher physician perceptions of LIFT referral may also be a product of the differences in the amount of time that physicians and care coordinators spend with patients. For example, a standard physician appointment lasts 10-15 minutes whereas care coordinators meet with patients for 30-45 minutes to assess patient needs by focusing on health promotion, health education, management of symptoms, etc. [17,

41]. Specific to this study, care coordinators may better understand the appropriateness of this type of physical activity program for patients. Future work incorporating focus group or individual interviews is needed to understand physicians' and care coordinators perceptions of LIFT referral.

Results of this study revealed a positive relationship between perceptions of feasibility, acceptability, and appropriateness of LIFT referral in the Carilion Clinic health care system and interest in pilot testing the referral scheme in practice by care coordinators. More than half of the care coordinators in attendance at the quarterly meeting reported interest in pilot testing LIFT referral in their Carilion Clinic practice. It has been hypothesized that the implementation outcomes of feasibility, acceptability, and appropriateness, are leading indicators of evidence-based program adoption [33], although predictive validity data does not yet exist [34]. Logically, interventions with greater relative advantage and compatibility within the intended delivery setting are more likely to be adopted [42].

Although there was initial interest in pilot testing, care coordinators also identified barriers to LIFT referral. The most commonly mentioned barriers by care coordinators and physicians were participant barriers. Care coordinators were most cautious of the cost to participants, transportation, and location and similarly, physicians were most concerned with cost, transportation, and patient buy-in. The above barriers are supported in the literature as commonly reported barriers of exercise by older adult individuals [43]. However, the most commonly reported barriers of physical activity promotion in the health care system are system- or staff- level barriers and include; lack of reimbursement for efforts, lack of time, lack of system/organizational support, and lack of awareness [9, 17, 44, 45]. Understanding these

barriers exist prior to implementation of LIFT referral allows stakeholders to re-assess strategies for reducing potential barriers to aging adult participants.

There are strengths and limitations to note for this study. First, while working through an IRPP has shown to be effective for translation of evidence-based programs into practice-based settings [29, 46, 47], this approach is very complex [36] and we were unable to provide preliminary evidence that this research approach speeds translation over other research methods. Specific to this study, threats of member turnover and structural changes within the organization resulted in significant delays to the projected timeline. Investment of time, commitment, and continued efforts toward fostering ongoing and new relationships are key ingredients to successfully build a trusting partnership [48, 49]. Second, results of the survey data informed stakeholders that LIFT referral was perceived as feasible, acceptable, and appropriate by care coordinators and physicians within Carilion however, not all care coordinators reported interest in pilot testing LIFT referral within their clinic. For example, care coordinators representing the Shenandoah Valley had highest perceptions of feasibility, acceptability, and appropriateness when compared to care coordinators who represent the other three regions but only seven of the nine agreed to pilot test LIFT referral within their clinics. Future in-depth surveys or focus group sessions may be beneficial in gathering a greater understanding of the perceptions of feasibility, acceptability, appropriateness and barriers for LIFT referral adoption within Carilion Clinic specific to each region. However, integration of LIFT referral within Carilion Clinic has potential to improve the scalability and system- and individual-level maintenance outcomes of LIFT across Virginia. Third, although the partnership included members of the academic-, clinical-, and Extension continuum, we were unable to match the *supply* of trained Extension health educators to the *demand* for LIFT referral. It is evident that there remains a need for

providing Extension health educators with additional training on the delivery of LIFT prior to implementing LIFT referral within the Carilion health care system so that care coordinators could in fact refer their patients to participate in a LIFT program within their surrounding areas. Future initiatives should include ongoing training (in-person or online) to increase the number of Extension health educators who are eligible and willing to deliver LIFT for successful translation of LIFT referral into a large health care system such as Carilion Clinic.

Future work should aim to expand the IRPP to include additional stakeholders who may be interested and eligible to deliver LIFT (e.g., church leaders, personal trainers, aging adult volunteers, etc.) within surrounding Carilion Clinic regions. Increasing the number of trained, eligible, and willing delivery personnel will, 1) allow members of the IRPP to move forward with further designing, developing, and delivering the referral scheme and 2) will balance the 'supply' to better match the 'demand' of LIFT referral within Carilion Clinic's health care system. As a result, a greater number of patients will be reached and impacted by the LIFT intervention through improvements in functional fitness.

Implementing LIFT referral into Carilion Clinics health care system has the potential to 1) *Reach* a greater proportion and representative sample of aging adults within the community, 2) improve functional fitness change scores and A1c levels (*E*ffectiveness), 3) improve system-wide *A*doption of LIFT referral by health care providers and their clinics, 4) can be easily *I*mplemented by a multiple health care providers who have contact with aging patients, and 5) sustain *M*aintenance of LIFT with the addition of a patient referral scheme. Implementation of an intervention may be unsuccessful without first understanding the potential fit of an intervention within the intended delivery setting. Staff- and system- level perceptions of intervention fit may be indicative of other implementation outcomes such as adoption, which is key a precursor for

implementation success. Assessing perceptions of feasibility, acceptability, and appropriateness when planning for implementation will help guide research questions that best fit 'next steps' for the planning and evaluating process of intervention translation.

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General Conclusions

Strength-training has shown to positively influence the health and functional fitness of older adults [1-4]. Unfortunately, less than 10% of older adults engage in adequate strength-training to have an impact on overall health [5], which may be a result of physiological, psychological, or sociological barriers [6, 7]. A variety of evidence-based strength-training interventions (home-based, supervised, group-based, etc.) [1-3, 8] have aimed to help older adults overcome such barriers and improve health related outcomes however; they have not shown sustainable changes in strength-training behaviors. This lack of sustained behavior change indicates a lack of translation within practice-based settings (e.g., community, clinical) to have a public health impact.

This dissertation outlines an IRPP approach to effectively translate evidence-based interventions into practice-based settings through use of the RE-AIM (**R**each, **E**ffectiveness, **A**doption, **I**mplementation, **M**aintenance) framework. Specifically, this dissertation provides support for the approach to 1) identify and adapt an evidence-based strength-training intervention with research- and practice-based adaptations that align with the mission, values, and needs of a community setting, 2) deliver the intervention to ensure that research- and practice-based adaptations did not compromise the reach or effect of the intervention, 3) link academic-community- and clinical stakeholders to bridge the gap between evidence and practice and 4) assess clinical perceptions of feasibility, acceptability, and appropriateness of referring patients to a community-based intervention prior to intervention implementation.

As seen in Manuscripts 1 and 2, health educators are likely to adopt an intervention with greater fit within their delivery setting and deliver the intervention with high fidelity, or deliver it as intended. Delivery of an intervention with high fidelity is fundamental to ensure the intervention effectiveness on older adult strength-training behaviors is not compromised. For

example, an intervention may be effective in one setting, but if it is translated into another setting and not delivered as prescribed, effectiveness may be compromised. Manuscript 1 provides support for the delivery of an evidence-based intervention that has undergone practice- and research-based adaptations through the scope of an IRPP to improve the reach and effect of the intervention. As a result of greater health educator adoption rates, the adapted, group dynamics-based intervention was able to reach and retain a greater number of older adult individuals and therefore, improved the functional fitness (e.g. strength, flexibility, agility, etc.) of those older adults reached.

Finally, Manuscript 3 features a novel approach that expands the IRPP to link stakeholders across the academic-, clinical-, and Extension- continuum to better bridge the gap between research-, practice-, and community-health promotion programs. This approach is novel in that there are few successful IRPP's that have worked in collaboration to link stakeholders across all three: academic-, clinical-, and Extension- settings. The purpose of expanding the IRPP was to enable researchers to transfer knowledge to both clinicians and community stakeholders while linking them together to improve the awareness, reach, effect, and sustainability of evidence-based interventions in practice-based settings.

After formation of the IRPP, partners planned and evaluated potential implementation of the evidence-based intervention within the clinical system. First, it was essential to assess clinical perceptions of intervention feasibility, acceptability, and appropriateness. Understanding the degree of intervention 'fit' within the clinical setting, further enhanced the potential success of intervention implementation within the intended delivery setting. Garnering the opinions of clinical stakeholders, informed the IRPP of potential barriers to adoption that can be addressed

and overcome prior to translating the intervention into the intended delivery setting, to further improve intervention reach and effect.

Forming an IRPP with an academic entity and community setting (e.g., Extension) was an effective approach to systematically identify, adapt, and deliver an evidence-based intervention that aligned with the mission, values, and resources of the community setting. Employing the RE-AIM framework to plan, evaluate, and tailor the intervention to satisfy the staff- and system-level needs resulted in an intervention with greater 'fit' within the intended delivery setting. The eight-week, group dynamics-based, health-educator led intervention was translated into the intended delivery setting, implemented with high fidelity (or delivered as intended) and sustained beyond the length of the intervention. Although this manuscript did not report a change in translational lag time, it did highlight the importance of transparently reporting real-world adaptations and lessons learned to advance the usefulness and translation of the intervention within the practice setting.

As evidenced throughout this dissertation, use of an IRPP was a novel and effective approach to assess perceptions of feasibility, acceptability, and appropriateness of integrating an evidence- and group dynamics-based strength-training intervention into the intended delivery setting to understand the potential intervention effect on functional fitness and physical activity behaviors of older adult patients. Retention rates of LIFT were comparative to other group dynamics-based interventions found in the literature however, mediation analyses are still needed to understand the relationship between group dynamics-based interventions and retention rates of older adult participants as retention rates were not significantly different from a non-group dynamics-based intervention (SSSH).

Planning and evaluating through the RE-AIM framework enabled academic-, clinical-, and community- professionals to collaboratively adapt the evidence-based intervention based on the knowledge, skills, and available resources to increase the 'fit' for the intended staff- and system-level practice-setting, resulting in improved uptake and implementation. As stakeholders work collaboratively through an IRPP approach to help reduce the barriers and challenges of clinical-community linkages for improved intervention implementation, they may also build the literature-base for improvements in translational lag-time of evidence-based interventions implemented successfully in practice-based settings. Together, academicians, healthcare providers, and community organizations can work toward shifting the priority and integration of promoting physical activity for patients into their daily routine to reach a greater number of sedentary older adults to improve their functional fitness, allowing them to live independently longer.

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Appendix A: IRB Protocol Approval Letter

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: January 20, 2018

TO: Samantha Marie Harden, Meghan Wilson, NithyaPriya Priya Shivanthi Ramalingam, Thomas Edward Strayer III, Stephanie Ann Breig, Laura Elizabeth Balis

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires January 29, 2021)

PROTOCOL TITLE: LIFT: A multi-state older adult strength-training program

IRB NUMBER: **16-032**

Effective January 18, 2018, the Virginia Tech Institution Review Board (IRB) approved the Continuing Review request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 4,7**
Protocol Approval Date:	**February 3, 2018**
Protocol Expiration Date:	**February 2, 2019**
Continuing Review Due Date*:	**January 19, 2019**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix B: Health Educator Process Evaluations

	Week:	**Week:**
Date:		
Instructor ID:		
Temp./Weather:		
# Of Participants Registered:		
# Of Participants Present:		
Scheduled Start Time:	_____AM or _____PM	_____AM or _____PM
Actual Start Time:	_____AM or _____PM	_____AM or _____PM
Were session materials set-up prior to start time?	Circle: Yes No	Circle: Yes No
Was warm-up completed as described in manual?	Circle: Yes No	Circle: Yes No
If no, what was different?		
How many participants completed the warm-up?		
Was the group activity completed as described in manual?	Circle: Yes No	Circle: Yes No
If no, what changes were made?		
Did participants engage in the group activity?	Circle: Yes No	Circle: Yes No
If no, what were they doing?		
How did you cope with participant behavior?		
Did you use the correct count for the 8 core exercises?	Circle: Yes No	Circle: Yes No
Did you complete all 8 exercises?	Circle Yes or No and fill in # of repetitions for set 1 & set 2	
Wide Leg Squat	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____
Leg Curl	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____
Knee Extension	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____
Side Hip Raise	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____
Biceps Curls	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____
Overhead Press	Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____

Seated Row Toe Stand	Yes or No 1)_____ 2)_____ Yes or No 1)_____ 2)_____	Yes or No 1)_____ 2)_____ Yes or No 1)_____ 2)_____
If no, what adaptations or changes were made?		
Was the cool-down completed as described in manual?	Circle: Yes No	Circle: Yes No
If no, what changes were made?		
Did participants complete the cool-down?	Circle: Yes No	Circle: Yes No
If no, what were they doing?		
If no, how did you cope with participant behavior?		
Did you review homework and reminders?	Circle: Yes No	Circle: Yes No
If no, why?		
Did participants engage in discussion or ask questions?	Circle: Yes No	Circle: Yes No
If so, were you able to answer questions?	Circle: Yes No	Circle: Yes No
Overall, was the session completed as intended?	Circle: Yes No	Circle: Yes No

THANK YOU!

Appendix C: Functional Fitness Assessment Protocol and Scoring Sheet

Functional Fitness Test for Older Adults

Guidelines:

- **Always give participant a demonstration of each assessment**
- **Participants are allowed 1-2 practice trials**
- **Do NOT encourage or motivate participants. (These tests should be performed at the participants best effort without assistance or encouragement from tester)**
- **If at any point the participant is in pain or discomfort, please ask them to stop assessment.**
- **Tester may act as a spotter for safety, if need be**

Functional Fitness Test: Graded Balance Test

Preliminary Test: Mountain Pose
Stand in front of chair or table with your feet side by side and touching. If you can remain in this position for 10 seconds, without using your hands for support, you may proceed to the other tests. If not, your balance is considered extremely poor and you should not attempt the following tests at this time.
Test 1: Tandem Stand
Stand to the side of counter and put your hand on it for support. Place one foot directly in front of the other. The heel of the front foot should be just touching the toes of the foot in the back. Distribute your body weight evenly on your two feet. Steady yourself and then let go of the counter. Hold this position for 10 seconds, without the aid of the counter, making sure your feet remain in contact with the floor. If you cannot complete this test, your balance is considered poor. Do not attempt other tests.
Test 2: One-legged Stand
Stand to the side of a chair or wall with your feet together and your hands on the counter for support. Shift your weight on to one foot. Bend the knee on the other leg to bring that foot up in the back. When you feel balanced on one leg, let go of the counter. Keep your hands poised so you can catch yourself if needed. Hold this position for 10 seconds—Foot up in back, without holding to the counter.
Test 3: Tandem Stand with Eyes Closed (spotter needed)
The position is the same as Test 1, except with your eyes closed. Hold the position for 10 seconds.
Test 4: Tandem Stand with Eyes Closed and Head Turning (spotter needed) This is the same as Test 3, only this time after you steady yourself and let go of the counter, turn your head slowly to the right, then slowly all the way to the left, and then return to face the front. Take 10 seconds to complete the turns from right to left to center.
Test 5: One-legged Stand with Eyes Closed (spotter needed)
This is the same as Test 2, except you will close your eyes. Hold the position for 10 Seconds.

Functional Fitness Test: 30-Second Chair Stand

Purpose: to assess lower body strength
Equipment: Stopwatch, straight-back or folding chair (without arms), height approximately 17 in. For safety, place chair against a wall to prevent it from moving during test.
Protocol: Participant should be seated, back straight, and feet flat on the floor. Arms are crossed at the wrist and held against the chest. On 'go' the participant should rise to a full stand and then return to a fully seated position. The participant is encouraged to complete as many full stands as possible in 30 seconds.
Scoring: The score is the total number of stands executed correctly within 30 seconds. If the participant is more than half way up at the end of 30 seconds, it counts as a full stand.

Functional Fitness Test: Arm Curl

Purpose: To assess upper body strength
Equipment: Stopwatch, straight back or folding chair (without arms), dumbbells (5 lb for women, 8 lb for men).
Protocol: Participant should be seated, back straight, and feet flat on the floor. Weight should be held in dominant hand, by side (handshake grip). Test begins with arm down beside the chair. On 'go' the participant turns the palm up while curling the arm through a full range of motion and then returns to a fully extended position (handshake grip).
The examiner should kneel next to the participant. Place one hand on bicep and one hand behind elbow. This will ensure the full arm curl motion as been made and prevent swinging of the participants arm forward and backwards.
Scoring: The score is the total number of curls made correctly within 30 seconds. If the arm is more than halfway up at the end, it counts as a curl.

Functional Fitness Test: 2- Minute Step Test

Purpose: To assess aerobic endurance
Equipment: Stopwatch, 30-inch ruler, masking tape
Set-up: The proper knee-stepping height for each participant is at a level even with the midway point between the patella (middle of the knee cap) and the iliac crest (top hip bone). This point can be determined using a tape measure or by stretching a piece of cord from the patella to the iliac crest, then folding it in half to determine midway point. Tape a ruler to the wall and mark the appropriate height for each participant.
Protocol: On 'go' the participant begins stepping in place, starting with right leg, and completes as many steps as possible within the time period. Both legs must reach minimum height but examiner only counts the number of times the right knee reaches minimum height. If that height can no longer be met, the participant is asked to stop. If they can resume with proper form within those two minutes, they can continue.
Scoring: The score is the total number of times the right knee reaches the minimum height. To assist with pacing, participants should be told when 1 min has passed and when there are 30 seconds to go.
Safety: Participant may place one hand on wall for balance.

Functional Fitness Test: Chair Sit-and-Reach

Purpose: to assess lower body (hamstring) flexibility.
Equipment: Straight-back or folding chair (17 in. ht), 18-inch ruler. Place chair against the wall and check stability.
Protocol: Participant should sit on the front edge of seat. The crease between the top of the leg and the buttocks should be even with the edge of the chair seat. Keeping one leg bent and foot flat on the floor, the other leg is extended straight in front of the hip, with heel on floor and foot flexed (at approximately 90 degrees).
With the extended leg as straight as possible, the participant slowly bends forward at the hip joint (spine should remain as straight as possible, with head in line with spine, not tucked) sliding the hands (one on top of the other) down the extended leg in attempt to touch the toes. Hold reach for 2 seconds. If the knee starts to bend, ask participant to slowly sit back and straighten leg. Remind participants to exhale as they bend forward.
Scoring: Using an 18-inch ruler, the scorer records the number of inches a person is short of reaching the toe (minus score) or reaches beyond the toe) plus score. The middle of the toe at the end of the shoe represents a zero score. Record two test scores to the nearest ½ inch, and circle the best score. Indicate minus or plus on the scorecard.

Functional Fitness Test: Back Scratch

Purpose: To assess upper body (shoulder) flexibility.
Equipment: 18-inch ruler (half of a yardstick)
Protocol: In standing position, the participant places the preferred hand behind the same-side shoulder, palm toward back and fingers extended, reaching down the middle of the back as far as possible (elbow pointed up). The participant places the other hand behind the back, palm out, reaching up as far as possible in an attempt to touch or overlap the extended middle fingers of both hands.
Without moving the participant's hands, the tester helps to see that the middle fingers of each hand are directed toward each other. The participant is not allowed to grab his or her fingers together and pull.
Scoring: The distance of overlap or distance between the tips of the fingers is measured to the nearest ½ inch. A minus score (-) is given to represent a distance short of touching; a plus score (+) represents the amount of an overlap. Record both test scores and circle the best one. The best score is used to evaluate performance. Be sure to indicate 'minus' or 'plus' on the scorecard.

Functional Fitness Test: 8-Foot Up-and-Go

Purpose: To assess agility and dynamic balance.
Equipment: Stopwatch, tape measure, cone (or marker), straight-back or folding chair (17 inches in height)
Set-up: The chair should be placed against a wall to ensure it does not move. It should be facing a cone/marker exactly 8 ft away (measured on the floor from the front point of the chair to the back of the marker). There should be at least 4 feet of clearance beyond the cone to allow ample turning room for the participant.

Protocol: Begin test with participant seated in the chair, hands on thighs and feet flat on the floor (one foot slightly in front of the other). On ‘go’ the participant gets up from chair (pushing off is allowed), walks as quickly as possible around the cone, and returns to the chair. The participant should be told that the test is time and to walk as quickly as possible around the cone and back to chair. The tester should stand between the cone and chair. Begin timer on ‘go’.
Scoring: The score is the time elapsed from the signal ‘go’ until the participant returns to a seated position. Record both test scores to the nearest 1/10th second and circle the best score (lowest time). Lowest score used for evaluation.

Functional Fitness Assessment

Name (first & last): _____ Circle: Pre or Post

County(ies): _____

Exercise	Scoring
Balance Station 1.Mountain Pose 2. Tandem Stand 3. One-Legged Stand 4. Tandem Stand w/ eyes closed 5. Tandem Stand w/ eyes closed & head turning 6. One-legged Stand w/ eyes closed	**1. Seconds _____** **2. Seconds _____** **3. Seconds _____** **4. Seconds _____** **5. Seconds _____** **6. Seconds _____**
30-second chair stand (number of stands)	**Trial 1**:_____ **Trial 2**:_____
Arm curl (number of curls) **Arm:_____**	**Trial 1**:_____ **Trial 2**:_____
2-Minute Step test (number of steps)	**Number of Steps: _____** **Height of each Step: _____**
Chair-sit-and-reach (seconds) **Leg: _____**	**Trial 1**: +_____ -_____ **Trial 2**: +_____ - _____
Back Scratch (inches) **Top arm:____**	**Trial 1**: +_____ - _____ **Trial** +_____ - _____
8-Foot Up-and-Go (seconds)	**Trial 1**:_____ **Trial 2**:_____

Appendix D: Session-by-session behavior change strategies and activities for LIFT

Session #	Session Objective	Targeted Principles	Why?	Suggested Group Activity
1	Introduction to program ***and*** group members.	-Interaction and communication	Everyone may or may not know each other. A game may act as an icebreaker and incorporates physical activity.	A. Active name game: With the group standing in a circle, have each person say their name and a corresponding exercise (e.g. Jumping Jack Jane). Everyone repeats the name and activity while doing the exercise and then the next person goes. *If the group is too large, just have each individual introduce themselves with a corresponding exercise and then have the next person go (without everyone repeating and doing the exercise).*
2	Introduce group members, create a team name, develop phone tree.	-Role within the group -Group distinctiveness/ team identity	Creating a phone tree encourages participates to communicate and support one another. Team distinctiveness enables participants to feel a sense of belonging to the group.	A. Phone tree: Ask participants if they are comfortable sharing their name and best contact method with the group. Assign group members to call individuals if they miss more than two classes. <u>Team distinctiveness:</u> B: Establish a group name for the cohort (e.g. Aged to Perfection, Generation Fit, Portsmouth LIFTers). C. Wear the same color t-shirts for class or community walks.
3	Collaborative group goal setting (physical activity completed	-Group goals -Group norms	Establishing a group goal sets a norm for class attendance and physical activity behaviors. A group goal encourages team	A. Set a group goal. Examples: 1. 80% attendance for at least 14 of the 16 sessions. 2. 'Walk the state.' Any 15 minutes of aerobic activity outside of class counts as a mile to walk across the state.

	class).		an individual goal would.	gets _____ (determine a nominal prize).
4	Discuss motivators of healthy lifestyle choices.	-Interaction and communication	Discussing personal motivators allows participants to learn about each other beyond surface level similarities and may enhance the positive group setting.	A. Discuss personal motivators for physical activity. Example prompts: 1. Discuss activities they remember doing as a youth. 2. Discuss activities, by the decade. What activity was your favorite in the 80s? 3. Talk about fruits and vegetables they enjoy growing or eating during certain seasons.
5	Develop plans for coping with physical activity barriers.	-Interaction and communication -Problem solving	Participants may have the best intentions when it comes to being physically active, but barriers consistently pop up. Group discussion allows participants to share challenges and barriers to support each other in overcoming common barriers	A. Share methods for coping with barriers (e.g. such as establishing routines, getting to bed earlier, etc.). B. List common barriers that people encounter. C. Discuss previous methods used for overcoming barriers in the past.
6	Determine what resources are available for physical activity.	-Action planning	If membership fees, transportation, time, etc. are barriers for engaging in physical activity, identify free and convenient options for physical activity. This may help further alleviate barriers to meeting physical activity recommendations.	A. Open discussion: Discuss how participants could use community resources (parks, recreation centers, etc.) to meet physical activity recommendations. B. List example exercises that can be done in community parks. (For example, use picnic tables for seated knee extensions and wide-leg squats or to provide balance for leg curls.)
7	Dietary behaviors influence physical activity	-Interaction and communication	Group discussion enhances a sense of 'belonging' among group members. The more opportunities they have to share information about themselves, the more	A. Ask participants to share favorite foods while exercising. B. Provide examples of snacks that 'fuel' the body. C. Distribute MyPlate for Older Adults (provided in

	participation.		they will feel connected to those they are exercising with. This may happen organically, but as the instructor, you can provide prompts to ensure that even the more introverted participants have the opportunity to chat and contribute.	manual).
8	Social integration and interaction outside of exercising.	-Group norms -Interaction and communication	Offer opportunities for participants to be rewarded and acknowledged for their healthy behaviors (class attendance, continued progress with physical activity, positive attitudes, etc.). Social gatherings outside of exercise enable participants to learn about each other.	A. Set up a potluck (for example, a midway point success potluck with healthy snacks). *If participants are coming from work or have obligations after class, another option is for the instructor to provide a healthy snack for participants along with the recipe.* B. Ask participants to bring a healthy recipe for a recipe exchange; discuss favorite healthy recipes during exercises. Or, ask participants to email their favorite healthy snack/meal recipes to the instructor; the instructor prints and brings them to next class.
9	Leadership roles to build confidence.	-Role within the group	Providing each participant with a role of 'leading' the group will help establish a sense of responsibility and accountability within the group. This may also help instructors identify people who may want to lead a class in the future.	A. Give participants the opportunity to 'lead' their group members through the exercises while counting out loud. *Ask for volunteers and for others to count.* B. Ask for at least one person to be the 'official counter' in class so that instructor can talk while doing the exercises.
10	Share successful behavior changes for	-Interaction and communication -Group size	Encouraging small group interaction while exercising (with a partner) permits members of the group to discuss and	A. Ask participants to work out with a partner in class. Each partner takes turns leading an exercise while the other counts out loud.

	physical activity and fruit and vegetable consumption.	-Feedback on goals -Social support	celebrate their improvements or find support where they still would like to make changes.	B. Ask partners to share achievements and healthy lifestyle behavior changes made thus far.
11	Revisiting group and individual goal setting.	-Social support -Interaction and communication -Feedback on group goals -Self monitoring -Tailoring	Revisiting group and individual goals allows participants to analyze their progress and/or make adjustments to their goals where needed. Re-addressing goals before the end of the program will help prevent relapse to being inactive.	A. Ask for volunteers to share their individual goals and how they feel they have contributed towards the group goal. B. Discuss any necessary changes to individual and group goals among the group. C. Discuss if participants want to continue to meet as a group. If so, discuss where, how, who would lead, etc.
12	Strategies for maintaining long-term health behavior changes.	-Interaction and communication -Self-monitoring	LIFT is about making lifelong changes—these topics and the opportunity for discussion can provide support in maintaining these changes.	A. Taking turns answering 'topic area' questions (voluntary and provided within manual) about motivators for physical activity, strategies to stay active, plans for staying physically active, etc. while exercising B. Ask for volunteers to answer the questions and lead group exercises.
13	Motivators of long-term health behaviors.	-Interaction and communication -Action planning -Relapse prevention	Individuals are encouraged to focus on the positive outcomes associated with the physical activity they have completed thus far and determine how they will translate these habits into their daily routines.	Lead a group discussion from topics included: A. What is different in their life/physical abilities now when compared to the start of class? B. How will participants stay accountable for their own healthy lifestyle choices (e.g. physical activity and fruit and vegetable consumption)? C. How will participants help each other stay accountable for their PA (e.g. continued use of phone tree)?

14	Establishing long-term coping and action plans.	-Interaction and communication -Action planning	Participants may want to remain physically active at the end of LIFT. Provide opportunities for participants to schedule time outside of LIFT to meet and remain physically active.	A. Ask for volunteers to discuss opportunities to meet for physical activity outside of LIFT. How will they help each other stay motivated and on track to accomplish goals? B. Invite the group to discuss what they need from you as the instructor or what opportunities they are curious about in the community. C. As the instructor, set up facility tours. Talk with local facilities about costs, classes, and opportunities for aging adults in the community.
15	Recognizing group member contribution.	-Group roles -Social support -Feedback	Urge participants to acknowledge and celebrate their team members (outside of group leader providing the encouragement).	A. Ask for volunteers to express who in their group was most enthusiastic, most encouraging, etc. It can be more than one person or everyone in the group. B. Go around in a circle and have each member say one positive attribute about the person to their right or how they've positively contributed to the team.
16	Acknowledge completion of group and individual goals.	-Feedback on group and individual goals -Group norms	Having an 'end of program celebration' encourages conversations outside of exercise. This helps build relationships that may motivate them to continue physical activity after LIFT.	A. Set up a potluck style social to celebrate accomplishments. B. As part of the celebration, if possible, provide some small incentives or prizes. Print out completion certificates for everyone. C. Ask participants to email recipes to instructors so that recipes or a 'LIFT cookbook' can be provided to everyone at the last class.

Appendix E: LIFT Surveys

(Pre-, 2-week, Post-, and 6-month follow-up)

Pre-Program Survey

LIFT Individual Registration Form Cover Sheet

Thank you for your interest in LIFT!

The following registration form asks several questions about you, your physical activity and what you eat. Your answers are important to us, as they will provide the basis for our evaluation of the LIFT program.

You will also be asked to complete the questions again at the end of the program. Your completion of the follow-up survey will help us see if the program helped you to make any lasting changes

All of the information that you provide will be kept confidential and we will not share your name or personal information with anyone outside of our evaluation group. This group includes Cooperative Extension and Virginia Tech Faculty as well as trained graduate students.

We also want you to know that some of the information you provide could be used for research purposes. However, the data used for investigation will not include your name or any other identifying information.

Thanks again for participating in LIFT and helping to evaluate the program!

By completing this form, I am providing my consent to partake in this research study.

LIFT Pre-Program Survey

Example: John Smith
First 3 letters of your first name: J O H
First 3 letters of your last name: S M I

First 3 letters of your first name: ___ ___ ___

First 3 letters of your last name: ___ ___ ___

Month and Year of Birth: Month:___ ___ Year: ___ ___

1. Your Height: _____Feet _____Inches
2. Your Weight: _____pounds
3. Are you? □$_0$ Male □$_1$ Female
4. Do you consider yourself to be Hispanic or Latino? □$_1$ Yes □$_0$ No
5. Please indicate which of the following best describes you (check all that apply):
   - □$_1$ White or Caucasian
   - □$_2$ Black or African American
   - □$_3$ Asian
   - □$_4$ American Indian/Alaskan Native
   - □$_5$ Native Hawaiian or Other Pacific Islander
   - □$_6$ Not sure
   - □$_7$ Other: _____

6. Have you participated in a Cooperative Extension program previously?
   □$_1$ Yes □$_0$ No

7. Have you previously participated in the LIFT program?
   □$_1$ Yes □$_0$ No

8. What is your present employment status?

□$_1$ Employed for wages
□$_2$ Self-Employed
□$_3$ Out of work for more than 1 year
□$_4$ Out of work for less than 1 year
□$_5$ A homemaker
□$_6$ A student
□$_7$ Retired
□$_8$ Disabled/unable to work

9. Please mark the highest grade of school that you have completed.
   - □$_1$ Less than High School
   - □$_2$ High School Graduate
   - □$_3$ Some college

□$_4$ College graduate
□$_5$ Post college work

10. In general, compared to other persons your age, how would you rate your health?

□$_1$ Extremely healthy
□$_2$ Somewhat healthy
□$_3$ Not healthy
□$_4$ Very unhealthy
□$_5$ Don't know

The following questions pertain to your fruit and vegetable consumption:

11. On average, how many cups of fruit do you eat each day? _____

12. On average, how many cups of 100% fruit juice do you drink each day? _____

13. On average, how many cups of vegetables do you eat each day?_____

14. On average, how many cups of 100% vegetable juice do you drink each day?_____

15. How were you recruited to the LIFT program? (Please check all that apply)

□$_1$ Newspaper
□$_2$ Online
□$_3$ Flyer
□$_4$ Friend
□$_5$ Extension Agent
□$_6$ Community Newsletter
□$_7$ Family
□$_8$ Care Coordinator
□$_9$ Other_____

Physical Activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

16. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities ***Skip to question 18***

17. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

18. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities ***Skip to question 20***

19. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

20. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking ***Skip to question 22***

21. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

22. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

23. How confident are you that you can engage in moderate physical activities (e.g., not exhausting, light perspiration) for 30 minutes for 2 or more days per week?

$□_1$ Not at all $□_2$ Somewhat $□_3$ Moderately $□_4$Very $□_5$ Completely

Social Network: Please answer the following questions related to your social network.
Over the last <u>two</u> weeks:

24. How many times have you spoken to relatives on the phone? _____
25. How many times have you spoken to friends on the phone? _____
26. How many times have you seen relatives (not living in home) in person? _____
27. How many times have you seen friends in person? _____
28. How many times have you participated in a group event? _____
29. How many times have you gone to a social gathering? _____

Thank You!

LIFT 2-Week Survey

First 3 letters of your first name: ___ ___ ___

First 3 letters of your last name: ___ ___ ___

Month and Year of Birth: Month:___ ___ Year: ___ ___

The following questions correspond to your personal involvement with your LIFT group, as well as your perceptions about the program as a whole.

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1. I like the amount of physical activity I get in this program.	1□	2□	3□	4□	5□
2. I am happy with the types of physical activities offered in this program.	1□	2□	3□	4□	5□
3. I am attracted to this program because of the potential health benefits.	1□	2□	3□	4□	5□
4. My group is an important social outlet for me.	1□	2□	3□	4□	5□
5. I enjoy my social interactions within this group.	1□	2□	3□	4□	5□
6. If I stopped being in my group, I would miss my contact with the other members.	1□	2□	3□	4□	5□
7. Our group is united in its beliefs about the benefits of the physical activity offered in this program.	1□	2□	3□	4□	5□
8. We encourage each other in order to get the most out of the program.	1□	2□	3□	4□	5□
9. Our group works together to achieve our physical activity goals.	1□	2□	3□	4□	5□
10. Our group socializes outside of our interactions related to LIFT.	1□	2□	3□	4□	5□
11. Our group spends time socializing with each other.	1□	2□	3□	4□	5□
12. Our group members like one	1□	2□	3□	4□	5□

another.					
13. Group members value the social interactions of our group.	1□	2□	3□	4□	5□
14. The social interactions I have with my group are important to me.	1□	2□	3□	4□	5□
15. I try to do the same things that the healthiest people in my group are doing.	1□	2□	3□	4□	5□
16. I would like to be the healthiest person in my group.	1□	2□	3□	4□	5□
17. There is friendly competition within our group to stay as healthy as possible.	1□	2□	3□	4□	5□
18. People in my group talk about things that are happening in our lives.	1□	2□	3□	4□	5 □
19. Our group discusses the importance of regular physical activity.	1□	2□	3□	4□	5□
20. Members of our group talk about how often they should do strength-training.	1□	2□	3□	4□	5□
21. Members of our group discuss the appropriate type of physical activity we should do.	1□	2□	3□	4□	5□
22. Members of our group talk about exercise and physical activity a lot.	1□	2□	3□	4□	5□
23. We all cooperate to help the program run smoothly.	1□	2□	3□	4□	5□
24. Our group cooperates to satisfy group member's preferences within the program.	1□	2□	3□	4□	5□
25. Members of our group cooperate well together.	1□	2□	3□	4□	5□

26. OVERALL, I feel that I am similar to other members of this group

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
□	□	□	□	□

27. How many members of the class do you feel that you are similar to?

□$_1$ None □$_2$ A few □$_3$ Some □$_4$ Most □$_5$ All

28. Over the last two weeks the hand and ankle weights used were:

Extremely Useful	1□	2□	3□	4□	5□	6□	7□	Extremely Useless

29. How confident are you that you can engage in moderate physical activities (e.g., not exhausting, light perspiration) for 30 minutes for 2 or more days per week?

□$_1$ Not at all □$_2$ Somewhat □$_3$ Moderately □$_4$Very □$_5$ Completely

30. The frequency I used the ankle and hand weights in class during the LIFT program was:

□$_1$ Never □$_2$ Rarely □$_3$ Sometimes □$_4$ Often □$_5$ Always

31. I plan to use the hand and ankle weights during physical activity:

□$_1$ Never □$_2$ Rarely □$_3$ Sometimes □$_4$ Often □$_5$ Always

Thank you!

LIFT Post-Program Survey

First 3 letters of your first name: ___ ___ ___

First 3 letters of your last name: ___ ___ ___

Month and Year of Birth: Month:___ ___ Year: ___ ___

Select the best option:

1. Over the last two weeks the hand and ankle weights used were:

Extremely Useful	1□	2□	3□	4□	5□	6□	7□	Extremely Useless

2. The frequency that I used the ankle and hand weights during the L.I.F.T. program was:

$□_1$ Never $□_2$ Rarely $□_3$ Sometimes $□_4$ Often $□_5$ Always

3. I plan to use the hand and ankle weights during physical activity:

$□_1$ Never $□_2$ Rarely $□_3$ Sometimes $□_4$ Often $□_5$ Always

Physical Activity

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least **10 minutes at a time.**

4. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities ***Skip to question 6***

5. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

6. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities ***Skip to question 8***

7. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

8. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking ***Skip to question 10***

9. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

10. During the **last 7 days**, how much time did you spend **sitting** on a **week-day**?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

11. How confident are you that you can engage in moderate physical activities (e.g., not exhausting, light perspiration) for 30 minutes for 2 or more days per week?

□$_1$ Not at all □$_2$ Somewhat □$_3$ Moderately □$_4$ Very □$_5$ Completely

	Completely Disagree	Disagree	Neither agree nor disagree	Agree	Completely Agree
12. I intend to do physical activity at least 3 times each week	□$_1$	□$_2$	□$_3$	□$_4$	□$_5$

The following questions correspond to your personal involvement with your LIFT group, as well as your perceptions about the program as a whole.

	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
13. I like the amount of physical activity I get in this program.	1□	2□	3□	4□	5□
14. I am happy with the types of physical activities offered in this program.	1□	2□	3□	4□	5□
15. I am attracted to this program because of the potential health benefits.	1□	2□	3□	4□	5□
16. My group is an important social outlet for me.	1□	2□	3□	4□	5□
17. I enjoy my social interactions within this group.	1□	2□	3□	4□	5□
18. If I stopped being in my group, I would miss my contact with the other members.	1□	2□	3□	4□	5□
19. Our group is united in its beliefs about the benefits of the physical activity offered in this program.	1□	2□	3□	4□	5□
20. We encourage each other in order to get the most out of the program.	1□	2□	3□	4□	5□
21. Our group works together to achieve our physical activity goals.	1□	2□	3□	4□	5□
22. Our group socializes outside of our interactions related to LIFT.	1□	2□	3□	4□	5□
23. Our group spends time socializing with each other.	1□	2□	3□	4□	5□
24. Our group members like one another.	1□	2□	3□	4□	5□

25. Group members value the social interactions of our group.	1□	2□	3□	4□	5□
26. The social interactions I have with my group are important to me.	1□	2□	3□	4□	5□
27. I try to do the same things that the healthiest people in my group are doing.	1□	2□	3□	4□	5□
28. I would like to be the healthiest person in my group.	1□	2□	3□	4□	5□
29. There is friendly competition within our group to stay as healthy as possible.	1□	2□	3□	4□	5□
30. People in my group talk about things that are happening in our lives.	1□	2□	3□	4□	5 □
31. Our group discusses the importance of regular physical activity.	1□	2□	3□	4□	5□
32. Members of our group talk about how often they should do strength-training.	1□	2□	3□	4□	5□
33. Members of our group discuss the appropriate type of physical activity we should do.	1□	2□	3□	4□	5□
34. Members of our group talk about exercise and physical activity a lot.	1□	2□	3□	4□	5□
35. We all cooperate to help the program run smoothly.	1□	2□	3□	4□	5□
36. Our group cooperates to satisfy group member's preferences within the program.	1□	2□	3□	4□	5□
37. Members of our group cooperate well together.	1□	2□	3□	4□	5□

38. OVERALL, I feel that I am similar to other members of this group

Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
$\square_1$	$\square_2$	$\square_3$	$\square_4$	$\square_5$

27. How many members of the class do you feel that you are similar to?

□$_1$ None □$_2$ A few □$_3$ Some □$_4$ Most □$_5$ All

28. What were your motivations for participating in this program?

29. What were the benefits of having this program available to you?

30. Please provide us with any additional comments you may have:

Thank you!

LIFT 6-Month Follow-Up Survey

First 3 letters of your first name: ___ ___ ___

First 3 letters of your last name: ___ ___ ___

Month and Year of Birth: Month:___ ___ Year: ___ ___

Physical Activity
We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least **10 minutes at a time.**

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

No vigorous physical activities ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.
3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

No moderate physical activities ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

□ Don't know/Not sure

The following questions pertain to your fruit and vegetable consumption:

8. On average, how many cups of fruit do you eat each day? _____

9. On average, how many cups of 100% fruit juice do you drink each day? _____

10. On average, how many cups of vegetables do you eat each day?_____

11. On average, how many cups of 100% vegetable juice do you drink each day? _____

12. How confident are you that you engage in moderate physical activity (not exhausting, light perspiration) for 30 minutes for 3 or more days per week?

$\square_1$ Not at all $\square_2$ Somewhat $\square_3$ Moderately $\square_4$ Very $\square_5$ Completely

Social Network: Answer the following questions related to your social network.
Over the last <u>two</u> weeks:

13. How many times have you spoken to relatives on the phone? _____
14. How many times have you spoken to friends on the phone? _____
15. How many times have you seen relatives (not living in home) in person? _____

16. How many times have you seen friends in person? _____
17. How many times have you participated in a group event? _____
18. How many times have you gone to a social gathering? _____

Over the next month:

22. I intend to do physical activity at least 3 times each week	1□	2□	3□	4□	5□
23. I plan to do physical activity at least 3 times each week.	1□	2□	3□	4□	5□
24. I am determined to do physical activity at least 3 times each week.	1□	2□	3□	4□	5□

Thank You!

Appendix F: LIFT Program Manual

Due to its large size and file format, the LIFT program manual cannot be added to this document.

The LIFT program manual is available upon request.

Appendix G: Physical Activity Readiness Questionnaire (PAR-Q)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.
If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to beingvery active, check with your doctor.
Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly:

Check: Yes or No.		
Yes	No	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
Yes	No	Do you feel pain in your chest when you do physical activity?
Yes	No	In the past month, have you had chest pain when you were not doing physical activity
Yes	No	Do you lose your balance because of dizziness or do you ever lose consciousness?
Yes	No	Do you have a bone or joint problem that could be made worse by a change in your physical activity?
Yes	No	Is your doctor currently prescribing drugs for your blood pressure or heart condition?
Yes	No	Do you know of any other reason why you should not do physical activity?

If you answered YES TO ONE OR MORE QUESTIONS:
-Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.
-You may be able to do any activity you want—as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those that are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
-Find out which community programs are safe and helpful for you.
Delay becoming much more active:
-If you are not feeling well because of temporary illness such as a cold or a fever—wait until you feel better; or
"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____ SIGNATURE _____

DATE_____ WITNESS _____

Appendix H: Physician Authorization Form

Physician Authorization Form

(Highlighted areas indicate areas to be completed by LIFT Instructor: remove this statement before printing/sending):

Physician/ Practice Name: _____

Address: _____
_____

Phone Number: _____ FAX Number: _____

Patient Name: _____

Program: ____Include brief description of program activities (e.g., strength-training, cardio, moderate intensity physical activity)_____

_____ Yes, my patient can participate.

_____ Yes, my patient can participate with the following limitations:
_____
_____
_____

_____ No, my patient cannot participate at this time due to his/her medical conditions and health status.

Physician's Signature: _____

Print Name: _____

This form may be faxed to _____, given to patient, or mailed to:
INSERT
ADDRESS
HERE
Please return this form by: _____ (Date) ___

Return Contact Information Here

Date

Dear Dr. _____,

Your patient, _____, would like to participate in a strength-training program.

As part of the Cooperative Extension mission to "put scientific knowledge to work through learning experiences that improve economic, environmental, and social well-being." Through a partnership of the land-grant universities of Virginia and community-based faculty and staff, these programs are developed and delivered through best practices and evidence and aim to improve health behaviors.

To determine if a participant may have a contraindication to physical activity, we have participants complete the Physical Activity Readiness Questionnaire before engaging in this particular program. Your patient has indicated an answer that requires us to obtain physician approval before he/she engages in the program, which includes moderate intensity physical activity (tailor as needed).

Please complete and sign the enclosed authorization form.

If you have any further questions about this program, please call me at _____.

Sincerely,

Name
Position
Location

Appendix I: LIFT Referral Feedback Survey for Primary Care Providers

Thank you for taking the time to complete this survey. Again, your responses are confidential and you can direct any questions about this survey and the research study to the study coordinator, Meghan Wilson. Email: meghan13@vt.edu
If you have questions regarding your rights and welfare as a study participant, please contact the Carilion Clinic Institutional Review Board. Email: mttalmadge@carilionclinic.org | Phone: 540-853-0728

LIFT

- LIFT is a strength-training program for older, insufficiently active older adults (Wilson et al., 2016)
- LIFT is an intervention adapted from another program that has been effectively delivered in population-based communities for over 20 years (Ball et al., 2013 & Seguin et al., 2008)
- LIFT is delivered by trained community-based health educators across the state of Virginia
- LIFT participants meet for one hour, 2x/week for 8 weeks to engage in strength-training exercises and aerobic activity that improve strength, balance, and flexibility of older adults on with in-person strength-training
- Based on existing literature, strength-training interventions may lead to increases in functional fitness, decreased insulin resistance and improved glycemic control, reduction in falls, improved mood and sleep, prevention or management of chronic disease, and ultimately, the ability of older adults to age in place or live independently longer (Seguin et al., 2003).

This section will help us learn more about the acceptability, appropriateness, and feasibility of LIFT within your practice.

I would refer older adult patients to LIFT because …	**Completely disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Completely agree**
1. LIFT meets my approval.	①	②	③	④	⑤
2. LIFT is appealing to me.	①	②	③	④	⑤
3. I like LIFT.	①	②	③	④	⑤
4. I welcome LIFT.	①	②	③	④	⑤
I would refer older adult patients to LIFT because the program seems:					
5. fitting.	①	②	③	④	⑤
6. suitable.	①	②	③	④	⑤
7. applicable.	①	②	③	④	⑤
8. like a good match.	①	②	③	④	⑤
9. implementable.	①	②	③	④	⑤
10. possible.	①	②	③	④	⑤
11. doable.	①	②	③	④	⑤
12. easy to use.	①	②	③	④	⑤

13. Please feel free to share any other feedback you may have at this time:

Thank you!

Appendix J: LIFT Referral Feedback Survey from Carilion Clinic Care Coordinators and Medical Office Assistants

LIFT Feedback Survey
Please answer these brief questions regarding LIFT.
We value your feedback and opinions.

1. Please select the region in which you serve through Carilion Clinic:
    ① Shenandoah Valley
    ② New River Valley East
    ③ New River Valley West
    ④ Roanoke Central & South

This section will help us learn more about the acceptability, appropriateness, and feasibility of adding LIFT to the current care coordinator toolbox.

I would refer older adult patients to LIFT because …	**Completely disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Completely agree**
1. LIFT meets my approval.	①	②	③	④	⑤
2. LIFT is appealing to me.	①	②	③	④	⑤
3. I like LIFT.	①	②	③	④	⑤
4. I welcome LIFT.	①	②	③	④	⑤
I would refer older adult patients to LIFT because the program seems:					
5. fitting.	①	②	③	④	⑤
6. suitable.	①	②	③	④	⑤
7. applicable.	①	②	③	④	⑤
8. like a good match.	①	②	③	④	⑤
9. implementable.	①	②	③	④	⑤
10. possible.	①	②	③	④	⑤
11. doable.	①	②	③	④	⑤
12. easy to use.	①	②	③	④	⑤

1. The most important reasons to refer patients to LIFT are:

2. What resources do you need that would enable you to refer patients to LIFT?

3. What resources do you currently have that enable you to refer patients to LIFT?

4. What are three barriers for referring patients to LIFT?

    1)

    2)

    3)

5. How do you see LIFT fitting within the existing care coordinator toolbox for healthy lifestyle resources?

6. Aside from Extension professionals, who do you think may be able to deliver LIFT sessions?