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Exercise Is Medicine in Oncology:

Engaging clinicians to help patients move through cancer

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ABSTRACT (200 words, limit = 200)

A compelling evidence base supports exercise as a safe, effective intervention to improve many cancer related health outcomes among cancer patients and survivors. Oncology clinicians play a key role in encouraging their patients to move more. Therefore, the oncology clinical care team is urged to do the following at regular intervals: ASSESS exercise levels, ADVISE patients to become more active, and REFER patients to specific exercise programming. It is recommended that a process be developed to incorporate these steps into the standard care of oncology patients. A simple, straightforward approach is recommended to discern whether patients should be referred to outpatient rehabilitation versus community based exercise programming. The exponential growth of exercise oncology research has driven the need for revised cancer exercise guidelines and a roadmap for oncology clinicians to follow to improve physical and psychological outcomes from cancer diagnosis and for the balance of life. This paper serves as a call to action and details pathways for exercise programming (clinical, community and self-directed) tailored to the different levels of support and intervention needed by a given cancer patient or survivor. Preserving activity and functional ability is integral to cancer care and oncology clinicians are key to providing these referrals.

Introduction

Multiple U.S. and international organizations have published exercise recommendations for patients living with and beyond cancer, including the American Cancer Society,[1] the American College of Sports Medicine (ACSM),[2] Exercise and Sports Science Australia,[3] Cancer Care Ontario,[4] and the Clinical Oncology Society of Australia.[5] In March 2018, ACSM convened a second roundtable on exercise and cancer prevention and control. This second roundtable included twenty organizations from multiple disciplines (see acknowledgements) and set out to review and update prior recommendations on cancer prevention and control. The products of this roundtable include three papers.

The first paper from the 2018 ACSM roundtable presents the evidence that exercise is associated with lower risk of developing cancer and improved survival following a cancer diagnosis.[6] A summary of the evidence from this review and the other recent reviews on this topic[7, 8] is provided in table 1. The ACSM expert panel concurred with other recent reviews and concludes that exercise prevents at least seven types of cancer and that there is substantial evidence suggesting exercise is associated with improved cancer-specific survival in breast, colon, and prostate cancer patients.

A second paper provides an update on the growing scientific evidence base supporting prescription of exercise to improve cancer related health outcomes (other than cancer diagnosis, tumor burden, recurrence, and mortality).[9] The ACSM expert panel concluded that there is sufficient evidence to support the efficacy of specific doses of exercise training to address cancer related health outcomes, including fatigue, quality of life, physical function, anxiety, and depressive symptoms.[9] There is also sufficient evidence to confirm the safety of resistance exercise training among patients with and at risk for breast cancer related lymphedema.[9] A summary of this evidence is provided in Table 2. This 2018 review of evidence retained the conclusions from the 2010 Roundtable that exercise training and testing was

generally safe for cancer survivors and that every survivor should “avoid inactivity”.[2] For the update, specific exercise prescriptions were generated for cancer-related health outcomes where there was strong evidence of an exercise benefit. In brief, the expert panel found that the majority of cancer health related outcomes in the ‘strong’ evidence category of table 2 are improved by doing thrice weekly aerobic activity for 30 minutes, and that there is also evidence for benefit for most of those same outcomes from twice weekly resistance exercise, one exercise per major muscle group, 8-15 repetitions per set, two sets per exercise, progressing with small increments. Where there was moderate evidence or insufficient evidence of an exercise benefit either an emerging exercise prescription or no prescription was generated, respectively.

This manuscript, the third in this triad, identifies and uses elements from ACSM’s Exercise Is Medicine initiative to propose solutions to overcoming barriers to exercise referrals by oncology clinicians. [1-5, 10]

Despite the exercise recommendations noted above, an analysis of over 9000 cancer survivors from the American Cancer Society’s SCS-II cohort indicates that only between 30-47% met current physical activity guidelines.[11, 12] In the HINTs cohort, 45% of cancer survivors reported regular physical activity, though this varied by tumor site (32% versus 53% in breast versus prostate cancer survivors, respectively).[13] Data from the U.K. indicated 31% of people living with and beyond cancer are completely inactive.[14] Reasons for lack of regular exercise among people living with and beyond cancer are multi-factorial, but multiple studies document a lack of recommendation from an oncology clinician.[15-17] Multiple studies of breast, colorectal, prostate and a mixed cohort of cancer survivors noted that over 80% of patients were interested in receiving advice from their oncology care team.[18-20] Despite this, studies suggest that 9% of nurses and 19 to 23% of oncology physicians refer cancer patients to exercise programming.[12, 17, 21, 22] A recent survey of 971 oncology clinicians that was conducted by the American Society of Clinical Oncology (ASCO) indicates that 78.9% of respondents agreed that oncology

clinicians SHOULD recommend physical activity to their patients.[23] Observed barriers for clinicians referring patients to exercise programming include lack of awareness of the potential value of exercise in cancer populations, uncertainty regarding safety or suitability of exercise for a particular patient, lack of awareness regarding available programs to help facilitate exercise in cancer populations, need for education and skills development for making referrals, and a belief that referrals to exercise programming is not within the scope of practice for oncology clinicians.[21, 22, 24-26]

In summary, the scientific evidence base supports exercise, and patients and clinicians generally agree that patients should be moving through their cancer therapy and survivorship. Translating from the current state to exercise assessment, advice, referral, and engagement as standard practice for all people living with and beyond cancer is a multifactorial puzzle to be solved. We recognize the need for improved awareness of benefits, clinician referrals, programming, workforce, systems for triage and referral, and other changes needed to realize sustainable increase in exercise among people living with and beyond cancer. At the end of this paper we present a call to action intended to clarify the many parts of a multiple systems level change needed to sustainably increase the proportion of people affected by cancer who exercise and/or keep physically active. Improvements in any one of these elements has the potential to solve a portion of this complex puzzle.

As such, the primary goal of this paper is to address the above noted barriers to oncology clinicians making exercise referrals standard practice, including provision of straightforward tools intended to make it easier for clinicians to recommend and refer patients to safe, effective and appropriate exercise programming. Other professionals can then take over for further assessment, triage, referral, or intervention, as appropriate. This paper provides instructions for advising and referring patients to appropriate exercise programming, guidance regarding incorporation of patient preferences and behavioral considerations when referring to exercise, and a description of examples of currently available exercise programs. We also present

challenges to implementation and propose actions required from relevant stakeholders to ~~can~~ help move oncology toward making exercise referrals a standard practice, a 'call to action'.

What Oncology Clinicians can do NOW: Assess, Advise, and Refer

The Exercise is Medicine (EIM) initiative was launched by the American College of Sports Medicine (ACSM) in 2007, with the goal of incorporating physical activity assessment, advice, and referral as a standard part of patient healthcare for the prevention and treatment of chronic diseases.[27] The EIM approach arose, in part, from successful clinical trials that trained primary healthcare providers (HCPs) to refer patients to exercise programming.[28, 29] These trials were informed by earlier successes in changing clinician behavior regarding use of the 5 A's for effective counseling for smoking cessation (e.g., ask, advise, agree, assist and arrange for follow up).[30] To date, the EIM approach has been adopted in several *primary* healthcare clinics, [31] as well as broadly across three large healthcare systems in the United States.[32-35] To date, there have been very few studies that used elements of EIM in the oncology care setting,[16] but there is ample scope and the need to examine integration into cancer care. The evidence base strongly supports adoption of the EIM approach for all patients with chronic conditions, including people living with and beyond cancer[9, 1-3, 5, 9, 23] and therefore, we propose the EIM approach as a way forward in the oncology setting.

Indeed, a recent publication from the American Society of Clinical Oncology recommends the 5 A's approach that is the basis of the EIM approach noted below.[23] Safety of these recommendations is supported by the finding of no adverse effects of exercise after cancer in general, or as recommended by oncology clinicians in multiple trials[16, 36] and multiple meta-analyses.[37-39]

The EIM approach includes assessment of physical activity as a vital sign**. Step 1: Assess**; review of the assessment by clinicians or their team prompts counseling and advice. **Assessing**

patients' physical activity at regular intervals, during medical visits, can function as a prompt to the patient-even if s/he has not acted on the provider's prior advice to become active. Asking about physical activity behavior conveys to the patient that their healthcare provider believes exercise is important to their functioning and recovery. Physical activity could become a vital sign, similar to blood pressure, and recorded in the electronic health record.[40] Multiple health systems across the U.S. have instituted the physical activity vital sign, including Prisma Health in South Carolina, Intermountain Health in Utah, and Kaiser Permanente.[32-35] In one study, it was observed that patients with advanced, unresectable lung cancer assumed their oncologists were familiar with their functional status and activity profile, and interpreted silence on these topics as tacit approval to maintain inactivity.[25] Whether this is the case for all people living with and beyond cancer is unknown. That said, there is clear evidence that patients are more likely to exercise if their oncologist tells them to do so.[16 17, 36] When patients understand that exercise can help in the management of cancer-specific symptoms (e.g., fatigue, poor physical functioning), they may become likely to act on provider advice.

Step 2: Advise; clinicians can advise patients to increase physical activity if they are not currently reaching recommended activity levels, which leads to referrals. **Step 3: Refer;** patients need referral to appropriate exercise programming based on their current activity levels, medical status, and preferences.[41, 42] Some patients may already be regular exercisers, and/or prefer to exercise on their own. However, especially during treatment, patients are at risk for developing side effects that are a barrier to exercise. Patients may underestimate how the treatment might affect their ability to exercise on their own. Also, current evidence indicates that exercise under supervision yields better outcomes.[9, 43-47] Therefore, even for currently active patients, regular evaluation of activity levels is needed, and referral to exercise programming could be valuable. The providers' willingness to discuss exercise during patient visits expresses confidence in the benefits of regular exercise during and following treatment. Referral to appropriate and effective programs and **follow up** with assessment of progress (or lack thereof)

at **subsequent visits** can serve as key transition points to change patient's behavior and impact their tolerance of or recovery from treatment.

It is also key that the clinical team repeat these three steps (Assess, Advise, Refer) and reinforce patients' efforts to increase exercise at regular intervals with assessment of new late-effects or other co-morbidities that may impede or modify participation in exercise programming. This approach is consistent with the UK National Health Service 'Making Every Contact Count' program,[48] which provides evidence based, hands on guidance for implementation of assessment, advice, and referrals to exercise programming at every clinical encounter.

The recommendation is that these three steps (Assess, Advise, and Refer) occur at regular intervals, at oncology clinical encounters of medical importance, as medical treatment changes occur, and/or as a patient reports a change in their functional status. It is recommended that a process be developed for incorporation of physical activity screening and referral into the standard care of oncology patients, much as has been recommended for distress screening.[49] These steps can also become part of care plans for survivors.

Within the first step (Assess), there are two questions to ask the patient (See Figure 1). Multiple valid and reliable short surveys have been developed for brief physical activity screening assessment in the clinical setting. Herein we recommend one question each about aerobic and resistance exercise derived from two brief physical activity screening surveys shown to have predictive validity for changes in obesity and other chronic disease outcomes.[33-35, 50] These two questions allow the clinical team to compare current activity level to recommended levels. The clinician then asks him/herself the third question (*Would this patient be safe exercising without medical supervision?)* to determine whether the patient is a suitable candidate for exercise outside of supervision by a healthcare professional (e.g.; physical therapist or clinical exercise physiologist). If the answer to question 3 is yes, oncologists are urged to provide the patient with a standardized prescription form (downloadable from the supplementary material section and from www.exerciseismedicine.org/movethruca) which calls

for the patient to perform an exercise dose of up to 30 minutes of moderate intensity aerobic activity, 3X/week and up to 20-30 minutes of resistance exercise 2X/week.[9] Based on the evidence review from the 2018 ACSM international, multidisciplinary roundtable on exercise and cancer prevention and control, this prescription is consistent with the minimal safe and effective dose to address anxiety, depressive symptoms, fatigue, quality of life, and physical function deficits,.[9] Clinicians will, of course, customize this prescription as they see fit.

However, there may be situations when the oncology clinician may NOT think the patient is safe to perform unsupervised exercise or may be unable to determine the answer to the third assessment question (e.g.; example patient #1 below). In this scenario, the patient should be referred to an outpatient rehabilitation healthcare professional for further evaluation and referral (Figure 1). Referral to outpatient rehabilitation may also be appropriate if the goal is to address a specific therapeutic outcome.[9]

To illustrate this system, we offer two examples. Patient 1 is a 75 year old man with aggressive prostate cancer, he has been on ADT therapy for 12 months. He has controlled hypertension, has a body mass index in the obese range, and a history of non-insulin dependent diabetes. He had a hip replacement 3 years ago. He still limps. In answer to the first two questions, he reports being completely sedentary. ECOG performance status is 2, but the patient reports difficulty walking. The clinician would refer him to an outpatient rehabilitation clinician (i.e., physiatrist, physical or occupational therapist). The outpatient rehabilitation clinician is well suited to assess, triage, and refer the patient to the appropriate exercise or rehabilitative programming.

Patient 2 is a 39 year old woman with stage 3 colon cancer, entering a 6 month course of chemotherapy. Her body mass index is in the obese range, but she has no other chronic conditions. In answer to the first 2 questions, she reports walking at lunch 1-2 times/week. ECOG performance status is 0. The clinician can use the Moving Through Cancer exercise referral form (Figure 3) to recommend increased exercise to 30 minutes of aerobic exercise 3

times a week and resistance training 2-3 times a week. If there is a local exercise oncology program known to the clinician, the patient can be referred directly there.

One key point to clarify is that oncology clinicians are not expected to give specifics of exercise prescriptions (e.g.; prescribe specific resistance training exercises, equipment, or progression of weights) or to do extensive screening and triage to determine whether exercise needs to be done in a rehabilitative versus community setting. Oncology clinicians, however, play a vital role in telling the patient that it is important to exercise and pointing patients in the right direction to make that happen. An analogy to this might be when the oncology clinician refers a patient to resources for psychosocial distress. The oncology clinician is not asked to clinically evaluate for depression, anxiety, or other conditions as if s/he has the same training as a clinical psychologist. However, the oncology clinician can play a crucial role in pointing the patient toward psychological services in the cancer center and in the community. The American College of Surgeons Commission on Cancer finds evaluation of psychosocial distress to be important enough that it is required that it be evaluated at regular intervals and that accredited cancer treatment centers must have a plan in place for evaluation and referral. The approach proposed herein could be step one toward a similar accreditation requirements for exercise referrals and a plan for regular assessment, advise and referral.

[9]Ideally, for the 3rd step (Refer), oncology clinicians can also identify local HCP-supervised or community based programming to which patients can be referred as a source of education, support, and supervision for meeting the recommended dose of exercise. As part of the efforts of the 2018 ACSM Roundtable, the authors have developed a registry with 257 programs from 20 countries that is described later in this paper.

Figure 1. about here.

Care coordination: Transitioning into and between Healthcare Provider Supervised vs Community Exercise Programming

At this time, referral to appropriate exercise programming is the goal, ideally achieved by having a healthcare professional with appropriate training for risk stratification and early detection of treatment-related adverse effects integrated into patients' clinical pathways. Integration of triage and referral into exercise programming directly into clinical pathways would ensure timely referral to the best suited professional, providing the right level of supervision, and practicing in the right setting. Multidisciplinary interventions would use a modular approach, to ensure optimal tailoring to the needs of individual patients. One model, as yet substantially untested, would be to hire exercise professionals and have them work alongside doctors and nurses in the oncology ward. A major barrier to implementing this approach is that, at present, there is no payment model that would support it. Regardless, in an ideal setting, a modular, multidisciplinary approach, including assessments of physical capacity and performance would be done at baseline and predetermined time points downstream and would be integrated into all exercise programs. Validated patient reported outcomes would be used to monitor health status, progress and evaluate the effectiveness of interventions. Periodic, structured evaluation of processes and outcomes (uptake, adherence, waiting lists) of healthcare provider supervised exercise programs would be undertaken to ensure continuous improvement of services. Finally, explicit attention would be paid to the timely, appropriate and successful transition from healthcare provider supervised exercise programs to community- or home-based services.[51-53] Transitions between healthcare provider supervised exercise programs and community programs are notoriously challenging. This underscores the need for the development of validated, evidence based, clear, safe and acceptable two-way triage guidelines that clarify who is NOT able to go directly to a community program run by trained fitness instructors, as well as symptoms that community based fitness instructors should monitor for referral back to healthcare professionals. There is programming in Canada and the Netherlands that have

achieved many of these aspirational goals.[51, 52] To expand availability of such high quality multidisciplinary, integrated exercise oncology care will require addressing reimbursement and workforce development issues reviewed later in the paper. In particular, it is currently unclear who should be in charge of the referral and triage process, who should begin the process, or who should be reimbursed or rewarded for actions related to assessment, advice, and referral to exercise and rehabilitative programming. In light of this current state, we recommend the use of the simple Exercise Is Medicine approach described earlier. In the absence of fully integrated systems, this will at least alert patients that their oncology clinicians hold the expectation of regular physical activity during and beyond treatment. A subset of patients is~~are~~ likely to be able to use these recommendations in self-directed programming. Another subset of patients will follow-up on a referral to outpatient rehabilitation.[54] The remainder likely need a greater infrastructure to support exercise for people living with and beyond cancer than currently exists in many settings. Waiting to start referrals until the full infrastructure is in place misses the opportunity for a greater proportion of patients to become active through the admittedly imperfect infrastructure that exists at present.

Behavioral Considerations and Patient Preferences

Exercise is only effective in improving clinical outcomes if the patient 'fills the script' (does the exercise program). Changing behavior is complex and depends on personal, social and environmental factors, as well as individual and community resources. Referral to an appropriate exercise specialist who can assess these factors and guide the patient to a program that best fits their needs and preferences will not only facilitate exercise adoption but also reduce the time burden on the medical professional (e.g., oncologist). The clinician's role of addressing the relevance of exercise for the specific patient, reinforcing behavior change and making appropriate referrals is key to starting the process For example, some patients need the support of group settings to adhere to exercise recommendations. Others may be unwilling to

participate in community-based group exercise classes (cancer specific or not) or in HCP-supervised programs, or may have concerns about body image (e.g., scars from surgery, dramatic weight gain or loss). Variability in confidence, self-efficacy, caregiver support and psychological factors (depression, anxiety) are important considerations in choosing exercise programming recommendations that are likely to net real and lasting behavior change. Environmental factors such as population density, local culture, walkability, safety concerns, and transportation constraints may limit the choice of exercise setting. The availability of HCP-supervised exercise programs may be limited by workforce challenges. Providers trained in cancer rehabilitation or cancer exercise training are unavailable in many geographical locations. Distance from clinical or community settings, program cost, local traffic conditions, or a lack of elder or childcare may make home-based exercise the best choice for many patients.[55-57] There is consistent evidence that supervised exercise is more effective, but that there is still benefit to home-based exercise.[9] Telemedicine or other distance-based approaches may help when healthcare provider supervision is needed but local programs do not exist. The ACSM registry of exercise programs for cancer patients can help providers to find programs that would be feasible, safe and appropriate for patients.

There have been numerous programs offered to improve an individual patient's adoption of exercise (see reviews[58, 59]). Several theoretical approaches have been used in such interventions (see reviews[60, 61 62]).Across the efficacy studies, techniques such as self-monitoring, goal setting, social support, feedback and problem solving, modeling, and feedback have been shown to be effective behavior change techniques.[44, 63] A meta-analysis of 14 RCTs among breast cancer survivors found that although large effects on physical activity are found in programs that provided more supervision, interventions by phone or email were also effective.[44] A recent comprehensive review of interventions for cancer survivors across different approaches, samples and settings (128 randomized controlled trials, 13,050 cancer patients)

revealed that the supervised programs produce larger effects on physical activity than unsupervised programs.[47] Another review concluded that interventions that have utilized behavioral theory tend produce the largest overall effect size for behavior change.[64] Interventions that may be less intensive can produce smaller effects on outcomes such as fitness and functioning; however, these interventions (distance based via print, telephone, web etc.) can reach more survivors and can be less burdensome for patients who experience travel and scheduling barriers. An update of a 2013 Cochrane review (23 studies, a total of 1372 patients treated for breast, prostate, colorectal and lung cancer) showed that programs that achieved adherence of 75% or more to exercise guidelines used techniques of goal setting, setting graded exercise tasks and instructions on how to exercise.[65] A synthesis of exercise programs that examined exercise maintenance (exercise assessed at least 3 months post-program completion) revealed that graded tasks, social support and action planning were used in studies sustaining significant behavior change.[66]

The successful promotion of exercise programming along the cancer continuum requires behavior change for many people affected by cancer. The behavior change is not only at the level of the individual patient as is commonly assumed (but has been extensively studied as indicated in the preceding paragraph) but also at the level of oncology clinicians, family, and community. The majority of programs require physician approval prior to patients' participation; hence, behaviors of oncology clinicians (e.g.; medical, surgical, or radiation oncologists; oncology nurse practitioners, oncology nurses, allied health professionals) are key to patients' being informed about and eligible to participate in programs and ongoing support for engagement in exercise programs. Although there are many competing considerations during oncology visits, particularly for patients undergoing treatment, the steps in recommending exercise do not require much time or skill by the oncology clinician and have been successfully integrated into cancer care follow-up visits.[67] Macmillan Cancer Support (a cancer charity in the

U.K.) has developed a guide to implementing exercise programming for those diagnosed with cancer.[36] While this 'how to' guide assumes access to the healthcare system in the U.K., the document includes evidence based instructions on implementation that are likely to be useful, and adaptable, to other countries with different healthcare delivery landscapes (e.g.; the United States).

Figure 2 around here.

Types of Programming

In figure 2, we demonstrate the range of possible programming to which patients can be referred during and after cancer treatment. The primary settings where exercise can take place include: 1) healthcare provider (HCP) supervised exercise programs – inpatient or outpatient ambulatory centers, public and private practice, where exercise is overseen by licensed healthcare providers and 2) community or home-based settings – specific local structured exercise programs in community or home-settings in which individuals with cancer can participate. Selection of setting is based on medical complexity and the ability of the patient to self-manage their condition.

First, however, it is important to clarify that patients are generally not referred once, to one setting. The representation of the two types of programs described below are provided here as examples, but in truth, there is a sequential (and perhaps even iterative) trajectory to referring patients to one type then another type of exercise or rehabilitative programming, given an aim of supporting patients throughout the cancer journey until the restoration of physical and emotional health and even beyond, for the balance of life. There is a need to clarify and simplify the process of getting patients into these programs by way of a referral from the oncology clinician. There is also a need to clarify how the practitioners in each setting can best refer to the other

possible settings. This is denoted in Figure 2 by the jagged line between the two program types, which are described below.

Healthcare Provider Supervised Exercise Programming:

A Healthcare Provider Supervised Exercise Program offers services that are delivered in formal medical settings such as inpatient and outpatient rehabilitation units, exercise facilities housed within medical settings, primary care settings and palliative or hospices care units. Healthcare professionals (e.g. physiatrists, physical therapists, clinical exercise physiologists, nurses, and/or occupational therapists) with expertise in the therapeutic use of exercise, supervise these programs. Patients can self-refer, but referrals are typically made by a physician with a patient's clinical status often determining the need.[68] Healthcare provider supervised exercise programs seek to progressively improve the physical fitness and the physical function of the cancer patient and survivor at all points along the cancer continuum. ~~These p~~Programs ~~are~~ offered during treatment seek to minimize treatment-related side effects and functional decline. Post treatment programs optimize recovery of physical functioning to a level that enables the survivor to engage in activities of daily living and to participate in the broader community, including long term maintenance of regular exercise in community settings.[68]

Patients with cancer related comorbidities or physical impairments, those at risk for developing these conditions, and those who require an individualized program to address a specific therapeutic outcome (i.e. peripheral neuropathy) may be best managed by a referral to a healthcare provider supervised exercise program. Such programs are staffed with healthcare professionals with the appropriate knowledge and skills to deliver exercise programs safely and efficaciously. High acuity cancer survivors may have needs in health domains (i.e. physical, psychosocial, nutritional) beyond just physical rehabilitation.[2, 3, 68 53] Healthcare provider supervised exercise programs typically have qualified staff to meet these additional needs.

There has been much discussion of the proportion of cancer survivors who would need this type of HCP supervised exercise program. A public health viewpoint might have clinicians refer every patient to (at the very least) a walking program. In contrast, clinicians who work in the setting of oncology rehabilitation have noted that even metastatic breast cancer patients unable to ambulate are not referred to rehabilitation.[69] To address the question of the proportion of survivors who might need supervised programming, a series of papers reviewed this issue in a variety of tumor sites, including breast, endometrial, head and neck, and colorectal cancer. . All four papers examined the likelihood of needing a supervised program at 6 months after the end of active cancer therapy, given review of published expert guidelines for discerning the need for supervision.[70] The proportion of endometrial, colorectal, head and neck, and breast cancer survivors who would need a supervised program were 80%, 58%, 60%, and 35%, respectively.[53, 71-74] Older age at diagnosis predicted the need for exercise supervision in all four tumor sites. Predictors of the need for exercise supervision also varied by tumor site: higher BMI in endometrial cancer; greater number of chronic disease comorbidities in colorectal cancer; higher BMI, and receipt of radiation therapy among head and neck cancer survivors; and, finally, black race, treatment with chemotherapy, and treatment with radiation predicted the need for supervision among breast cancer survivors. Ultimately, it is likely that there is a subset of patients for whom the best approach is referral to outpatient rehabilitation for additional assessment and referral to appropriate programming. The challenge is determining who these patients are without overburdening oncology clinicians.

A minimal requirement for providing services in a healthcare provider supervised exercise program is the availability of qualified healthcare professionals with specialized knowledge in physical therapy or clinical exercise physiology, exercise prescriptions, and oncology (disease management, acute and late effects of treatment). A healthcare provider supervised exercise program should also have a structured process to identify those ready to be referred to

community or home-based exercise programming or referred back to the oncology clinician for more specialized care. Clear communication among professionals providing clinical exercise services and clinicians involved in the cancer treatment should be ensured at all times.

An example of best practice in healthcare provider supervised exercise programs includes the ActivOnco [51] program in Quebec, Canada. Common to these programs are a well-defined multidisciplinary cancer care team, a person who guides the cancer survivor through the evaluation and treatment process, defined screening and evaluation processes which triage patients according to their medical status, rehabilitation needs and exercise eligibility, well defined referral pathways to guide patient care and communications between all parties involved.

Community based programs

Community based programs are, by definition, NOT based in a formal medical setting (e.g. hospital or rehabilitation center). Venues for these programs include local government municipal / community gyms; community halls, libraries and leisure centers; local charities and private gyms. Those referred to self-directed exercise programs may seek out community-based generic exercise classes and engage in outdoors activities such as walking or cycling. Patients connect to these programs either by self-referral or by referral from oncology clinicians. Many community programs involve screening and approval by the oncology clinician. The registry at https://www.exerciseismedicine.org/movethruca suggests that qualified fitness professionals, coaches, exercise physiologists or volunteers mostly provide the exercise instruction in the community setting.

Community-based programs are generally perceived to be more accessible and affordable and reduce the barriers of distance, cost and time compared with participation in an healthcare provider supervised exercise programs.[75 76] In a number of community settings, fitness instructors are trained specifically in cancer, including exercise guidelines and prescription, to

supervise the exercise sessions/classes. Examples of such training courses design by professionals with cancer exercise expertise include ACSM/ACS Certified Cancer Exercise Trainer (https://www.acsm.org/get-stay-certified/get-certified/specialization/cet) and CanRehab cancer exercise specialist courses (http://canrehab.co.uk/fitness-workshops/). This skilled workforce is relatively inexpensive and accessible, when compared to physical or occupational therapists or clinical exercise physiologists.[77] If neither is available, or if a patient is sufficiently mentally and physically able to participate in "regular" community exercise, directing patients to the most appropriate exercise opportunities (called 'signposting' in the U.K.) can be an effective way of providing access to a wide range of generic activities in the community. However, ongoing monitoring and behavioral change support by a cancer exercise professional for those opting for generic activities is essential for success. Currently**,** there are over a twenty publications describing the implementation and in many cases, the evaluation of community based programs for cancer patients and survivors in North America[78] Australia[79] and North Europe.[80] Below we describe the largest programs in the UK and the USA, respectively.

UK: MoveMore program

The UK cancer charity Macmillan Cancer Support worked with clinicians, service users, local decision makers, service providers and academics to develop an exercise intervention delivered as part of an integrated care pathway. This program initiates in the clinical setting and is followed by a behavior change-based intervention and utilization of exercise opportunities available in the community. MoveMore is not a typical very structured community based program, but rather MoveMore aims to provide a variety of exercise opportunities in the community to suit the service user and thus ensure behaviour change. MoveMore is based on guidelines stating that support should be provided for at least a year in order to bring about long-term behaviour change and the regularity and format of that support is informed by the individual's personal needs and preferences.[81] The exercise intervention options are varied and

always include “closed” i.e. cancer specific options in gyms and community funded facilities. Staff training for MoveMore is through the CanRehab cancer exercise specialist courses . Macmillan Cancer Support has provided 3 years of free programming for all people living with and beyond cancer, supporting the transition from local programs to a more sustainable model of care by providing resources and utilizing lessons learned to influence provision across the U.K.

USA: LIVE**STRONG** at the YMCA

The LIVE**STRONG** at the YMCA program adheres to ACSM guidelines for survivors engaging in exercise and has currently served over 60,600 people in 707 communities.[82] The program consists of two 90 min sessions per week for up to 12 weeks of small-groups (6-16 participants) led by YMCA exercise instructors who have completed specific training prior to working in the program (i.e.; nationally accredited fitness trainer certification, multiple prerequisite training sessions, a 2-day in-person workshop and a required online training on lymphedema). The program is free to survivors for at least 12 weeks, though some YMCAs allow repeated participation without cost. Instructors with strong relationship-building skills and expertise in exercise instruction are selected to become LIVE**STRONG** instructors. Instructors must maintain their certifications with qualified continuing education credits.

Both MoveMore and the LIVE**STRONG** at the YMCA programs have been independently evaluated and shown to be effective in significantly improving self-reported physical activity levels, quality of life physical function, and cardiorespiratory fitness.[77, 83]

Implementation Issues

Capacity for Triage and Referral

The precipitously increasing demands placed on oncology clinicians represent an important consideration in advancing the systematic integration of exercise into cancer care. A key factor not resolvable at this time is one of ensuring that every exercise program is safe, while still effective. The literature suggests that there are few adverse events from exercise in those living with and beyond cancer.[2, 9, 38, 39, 84] However, the concern regarding keeping patients safe continues to be raised.[22, 23, 26] In truth, adverse event reporting in the field of exercise oncology is not standardized. Event reporting should become standardized within exercise program for people living with and beyond cancer to gain the trust of the oncology clinical community.

Above we described the ideal scenario in which a multi-disciplinary team would work alongside oncology clinicians, assessing, triaging, and referring patients to appropriate programming. Until that occurs, there is a need for simple systems whereby referrals can be made to the appropriate source to further assess and triage, much like what currently happens with psychosocial distress assessment and referrals.

This all occurs in the setting of demographic shifting to a more geriatric and multi-morbid cancer population, as well as an expanding therapeutic arsenal and extended late stage survival collectively tax the human and institutional resources devoted to cancer care. Further, providers are being tasked with addressing multiple health conditions among cancer patients in addition to exercise counseling; e.g., fertility preservation, distress screening and management, survivorship care planning. All of these health conditions are to be addressed during patient visits of shrinking duration. The challenging reality of an under-resourced system confronting formidable demands is unlikely to change in the near-term. Therefore, effective strategies are needed that provide support to oncology clinicians as they work to assist their patients in becoming more active after a cancer diagnosis.

Possible solutions could include better integration of electronic medical record (EMR) data. Current generation EMRs have unprecedented capability to collect and synthesize diverse

sources of information related to patients' function, physical activity (self-report and from wearables), and adherence. By triangulating patient reported outcome, performance, and clinical data EMRs can populate algorithms which drive important dimensions of patient- and provider-EMR interfaces including alerts, messaging, document formatting, etc. Further, with increased use of on-line portals for patient-provider communication, these algorithms can trigger the automated delivery of educational materials for fitness and other activities directly to patients. The implications for directing survivors to needs-matched exercise and rehabilitation programming could be far-reaching and impactful. However, the net pros and cons of relying on EMRs to automate aspects of care that have historically been restricted to in-person, clinic-based delivery are not known. There is a pressing need for implementation science research on incorporation of the three proposed steps (Assess, Advice, Refer) into oncology clinical care, with and beyond use of the EMR.

Identification/awareness of healthcare provider supervised AND community based exercise programming: The Need for a Registry

To refer to exercise programming requires knowledge of existing programming and trust in the quality and safety of that programming. In preparation for the 2018 ACSM roundtable on exercise and cancer, we conducted an online survey of currently available exercise and rehabilitation programs worldwide. The survey was accessible via a public link. Respondents to the survey were recruited via emails to opinion leaders and organizations offering established programs, and researchers or clinicians identified through our professional network or based on prior scientific publications. Additionally, we used snowball sampling: everyone receiving the email invitation was asked to forward the email to anyone they thought might be able to provide further information on available programs. Also, a call for respondents was published via professional networks, including the network for oncology/HIV of the World Confederation of

Physical Therapy (IPT/HOPE), LIVE**STRONG**, ACSM, and the Commission on Accrediting Rehabilitation Facilities (CARF).

Of the 257 programs identified through this process, 181 are healthcare provider supervised exercise programs and 76 are community programs. These programs are located in South America, North America, Europe, Asia, Oceania and the Middle-East. ACSM is committed to keeping the registry updated with new programs on a regular basis, which is now available at www.exerciseismedicine/movingthruca.

A screening process for entry of validated programs into the registry and automated annual confirmation from the key contact is under development. To be included in the registry, all programs will provide evidence that the interventionists are appropriately trained and certified in that locality (e.g.; ACSM anywhere, CanRehab in the U.K.). Programs will also provide information on location, cost, length, frequency of sessions, and a detailed description of the program with regard to frequency, intensity, time, type, overload and progression of exercise. Finally, all programs will document their emergency procedures and referrals to/from health care professionals. Programs run within healthcare settings will be asked to provide evidence of licensure. Programs will be reviewed annually and lack of compliance will result in being removed from the registry.

The primary purpose of this registry is to provide a resource for clinicians and patients to more easily connect with health care provider supervised and community based exercise programs for people living with and beyond cancer.[2, 9, 38, 39, 84]

Cost and Compensation

Sustainable coverage for exercise programming remains an ongoing challenge in all countries, as does clarifying which stakeholders will contribute. Some countries reimburse rehabilitative

exercise programming under specific conditions (i.e. Australia, Germany, the Netherlands). Underfunding, however, is common even in countries with government subsidies.[85] For healthcare provider supervised exercise programs, third party payers may offer partial coverage yet gaps between insurance coverage and program costs may be insurmountable for many patients without institutional support. Funding for community-based programs, is often vulnerable and short-term.[86] Some LIVE**STRONG** at the YMCA and UK-based MoveMore projects transition into fee-based models after set intervals. These user-pay models potentially provide a sustainable option provided there is committed baseline financial support from a community partner.

A potential barrier to consistent third party coverage is marked variation in program costs. Inconsistencies can be partially explained by programs' differing resource intensities. Center-based, clinician supervised programs are notably more expensive. For example, Onco-Move, a home based, self-managed exercise program costs $53 per cancer patient, while OnTrack, a physical therapist (PT) supervised, facility based exercise program costs $866 per patient.[87] Both programs extend from the first chemotherapy visit to three weeks after the last chemotherapy visit. The expertise of the supervisory personnel also influences cost. The LIVE**STRONG** at the YMCA program costs less than OnTrack at $500 per patient, partially due to its reliance on exercise trainers rather than physical therapists.[88]

Reports suggest that resource intensive programs are more likely to be cost effective. A comparison of Onco-Move and OnTrack found that Onco-Move was unlikely to be cost effective apart from very high willingness to pay (WTP) thresholds. OnTrack, in contrast, had an incremental cost effectiveness ratio in comparison to usual care of €26,916/quality adjusted life years, which falls within some endorsed WTP thresholds.[87]

Reports additionally suggest that analyses including comprehensive costs which capture reductions in healthcare utilization more consistently favor resource and exercise intensive programs. A randomized trial that compared high- and low-intensity exercise programs found the former to be cost-effective, mostly due to significantly lower healthcare costs in high intensity exercise group.[89] Several studies noted reductions in unplanned hospitalizations, lengths of stay and ER visits among patients who participated in exercise programming. [90, 91] Although it is often assumed that multidimensional programs offer larger benefits, they are also inherently more expensive. It is yet unclear whether such programs are more cost-effective compared to monodimensional programs.[92] The association of greater value with more resource intensive programs complicates the challenge facing provider organizations seeking to offer programming that will benefit their patients. [87, 91]

Workforce Issues

The evidence base supporting referral to exercise programming during and after cancer treatment is not matched by a robust workforce prepared to triage, refer, coordinate care, and intervene with the 18.1 million new diagnoses annually or 44 million survivors currently alive worldwide.[93] For the full benefits of exercise during and after cancer treatment to be realized, workforce development is needed on multiple fronts.

Oncology Clinicians. Educational programs are needed to ensure that medical, surgical, and radiation oncologists, oncology nurse practitioners, nurses, and all other members of the cancer care team are cognizant of the value of exercise for their patients before, during and after active cancer therapies.[94] ACSM commits to developing and frequently updating an evidence review for oncology clinicians.

Healthcare professionals to deliver Supervised Exercise. Delivering high-quality care for individuals with cancer requires specialized knowledge and competency skills across the workforce of healthcare providers.[95] The current system for education and training in the specialty practice of oncology exercise and rehabilitation however is more aligned with healthcare and medical continuing education programming rather than codified in standardized medical, nursing, and physical therapy curriculum content and board specialty training and certification. Healthcare provider disciplines such as clinical exercise physiologists, physical therapists, and physiatrists have well described and standardized pathways for education and training that should be leveraged to improve knowledge and competency in oncology. Future opportunities to advance knowledge and skills in clinical exercise physiologists and physical therapists who deliver oncology exercise and rehabilitation include; standardizing entry-level curriculum content in oncology for degree and licensure[96], developing and expanding oncology rehabilitation residency programs[97], and development of cross-discipline clinical competencies that can be measured and translated into clinical practice.[98]

While these efforts are unique to each healthcare profession's scope of practice, there is a need for collaboration across disciplines to identify core, common oncology knowledge domains required to support safe and effective exercise programming and rehabilitation services. Workforce development for the healthcare professionals suited to lead oncology exercise programming will improve the density, credentialing, and visibility of these programs to meet the needs of those diagnosed with cancer during and beyond their treatment.

Community based exercise professionals

In a community setting, the workforce most likely (knowingly or unknowingly) to work with the cancer populations are fitness instructors / personal trainers based in locally-funded community halls and gyms and in privately-funded gyms and leisure centers. This workforce consists of three groups: staff directly employed by the community halls, gyms and leisure centers;

volunteers who work within this setting; and self-employed fitness instructors and personal trainers. There are few validated training pathways for preparing fitness instructors or volunteers to safely and effectively provide exercise programming to the cancer population in the community setting. One exception is in the UK where a structured pathway to gaining a qualification as a cancer exercise fitness instructor is available with all courses on the pathway validated and quality controlled by an overarching awarding body (CIMSPA https://www.cimspa.co.uk). Many qualified fitness instructors around the globe are part of a registry of exercise professionals. Individual countries manage their own exercise professional registries (e.g.; U.S.A., UK, Australia, New Zealand). The umbrella organization for these registries of certified exercise professionals is called the International Coalition of Registers for Exercise Professionals (ICREP) www.icreps.org). Registries within specific countries can be accessed from the ICREP website.

The training company CanRehab has provided the Level 4 Cancer Exercise Training for >700 fitness instructors in the UK. A prerequisite to obtaining this certification is to hold a nationally accredited personal trainer / exercise referral qualification, attend a 4 day training course, complete a case study submission and to pass a practical and written exam (>70%). Medical & allied healthcare professionals have endorsed the course. Most volunteers working with clients with cancer in the UK go through a standard core cancer awareness training program provided by Macmillan Cancer Support for all its volunteers. The rough equivalent to the CanRehab training and certification in the United States is a professional certification developed by ACSM in 2008, in partnership with the American Cancer Society for exercise professionals seeking to provide safe, effective exercise programming to those who have been diagnosed with cancer (ACSM/ACS Cancer Exercise Trainer Certification). The certification is undergoing an update in 2019.

Exercise Is Medicine In Oncology - A Call to Action

Overcoming the above noted barriers and making exercise assessment, advice, and referral a standard practice within clinical oncology will require action from multiple stakeholders.

Oncology Clinicians: **Assess** physical activity for all patients at regular intervals, continuously along the cancer continuum. **Advise** patients to move more and sit less. **Refer** to local healthcare provider supervised and community or home programs as appropriate. Develop a process to incorporate these steps into the standard care of oncology patients.

Policy Makers. Develop policies, programs and initiatives which facilitate the translation and funding (reimbursement) for implementation of clinical and community exercise programming across all cancer diagnoses and at all points on the cancer continuum. There are a multitude documented benefits of exercise during and after cancer treatment.[99] A drug with a similar benefit profile would likely be prescribed broadly.

Researchers. Adapt effective interventions for community and home-based settings. Conduct implementation science and health services research on clinical and community exercise during and after active cancer care to drive improvements in infrastructure, reimbursement and other policies that will make exercise standard practice in oncology.

Clinical Educators. Expand physical activity education in the training of all healthcare providers and social workers who are or will be a part of the oncology workforce. Develop the workforce for clinical and community exercise practitioners in oncology.

Healthcare providers (Physical Therapists, Clinical Exercise Professionals). Seek additional training to meet the unique needs of cancer patients and survivors. Demand new curriculum development to meet this unmet educational need.

Mainstream Health and Fitness Industry. While LIVE**STRONG** at the YMCA and the MoveMore program form successful models, they are not ubiquitous. There are many places in the U.S.A. and beyond where there are no available exercise programs for cancer patients and survivors. In 2014, revenues in the U.S. fitness industry topped $24 Billion dollars, and memberships are increasing steadily.[100] The industry has noted that smaller niche gyms gather cult followings. At 16 million survivors in the U.S.A., cancer survivors might be prevalent enough to form a niche (or two). The industry could benefit from, and benefit, cancer patients and survivors with high quality programming to which oncology clinicians could make referrals. While this evaluation is admittedly U.S. –centric, the facts are likely easily replicated around the world.

Oncology Patients and survivors. Oncology patients and survivors have a powerful voice in shaping oncology care. Multiple funding agencies now require patient advocates on projects to ensure that the voice of the patient is considered. If patient advocates spoke with one voice about asking for exercise assessment, advice, and referral to be standard practice, it would facilitate forward motion toward this goal.

Summary

The exponential growth of exercise oncology research has driven the need for revised cancer exercise guidelines[99] and a roadmap for oncology clinicians to follow to improve physical and psychological outcomes from cancer diagnosis and for the balance of life. This call to action details pathways for exercise programming (clinical, community and self-directed) tailored to the

different levels of support and intervention needed by a given cancer patient or survivor. Preserving activity and functional ability is integral to cancer care and oncology clinicians are key to providing these referrals. At the very least, oncology clinicians should:

1) Assess current physical activity at regular intervals
2) Advise cancer patients on their current and desired level of physical activity and convey the message that moving matters, and
3) Refer patients to appropriate exercise programs or to the appropriate healthcare professionals who can evaluate and refer to exercise.

Upon full development of the exercise oncology workforce, experts in cancer rehabilitation and exercise oncology recommend further changes to oncology clinical practice. These aspirations would elevate the potential to address the rehabilitative, exercise, and functional goals and outcomes during and after treatment.

Current practice is failing those diagnosed with cancer. This call to action for oncology clinicians, policy makers, researchers, educators, patients, and the health and fitness industry has the potential to transform the health and well-being from cancer diagnosis, through treatment, and for the balance of life.

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Meeting Attendees for the ACSM International Multidisciplinary Roundtable on Exercise and Cancer Prevention and Control

Name		**Organizational affiliation**	**Role**	
Katie	Schmitz	ACSM	Meeting Co-Chair	
Chuck	Matthews	NIH	Meeting Co-Chair	
Lynn	Gerber	AAPMR, FPMR	Organizing Committee	

Trisha	Hue	Sunflower Wellness	Organizing Committee
Steve	Morris	APTA	Organizing Committee
Alpa	Patel	ACS	Organizing Committee
Susan	Helmrich	Self	patient advocate
Catherine	Alfano	ACS	Presenter
Kristin	Campbell	CSEP	Presenter
Anna	Campbell	MacMillan	Presenter
Andrea	Cheville	AAPMR	Presenter
Kerry	Courneya	U Alberta	Presenter
Christine	Friedenreich	Alberta Health Services	Presenter
Sandi	Hayes	ESSA	Presenter
Lee	Jones	ASCO	Presenter
Jennifer	Ligibel	ASCO	Presenter
Steve	Moore	NIH	Presenter
Bernadine	Pinto	SBM	Presenter
Martijn	Stuiver	Royal Dutch PT Association	Presenter
Kerri	Winters-Stone	ACSM	Presenter

Joachim	Wiskemann	DGVS	Presenter
Bill	Bain	Sunflower	attendee
Leighton	Chan	NIH Clinical Center	attendee
Crystal	Denlinger	NCCN	attendee
Colleen	Doyle	ACS	attendee
Janet	Fulton	CDC	attendee
Daniel	Galvao	ESSA	attendee
Stephanie	George	NIH	attendee
Niraj	Gusani	SSO	attendee
Ana Valeria	Martin	University of Washington	attendee
Anne	May	Royal Dutch PT Association	attendee
Frank	Perna	NIH	attendee
Robert	Sallis	ACSM	attendee
Anna	Schwartz	Northern Arizona University	attendee
Julie	Silver	CARF	attendee
Fiona	Smith Flowers	MacMillan	attendee
Jonas	Sokolof	ACLM	attendee
Nicole	Stout	CARF	attendee

David	Zucker	AAPMR	attendee

Abbreviations: ACSM = American College of Sports Medicine; ACS = American Cancer Society; NCI = National Cancer Institute; AAPMR= American Association of Physical Medicine and Rehabilitation; CARF = Commission on Accreditation of Rehabilitation Facilities; ASCO = American Society for Clinical Oncology; ACLM = American College of Lifestyle Medicine; APTA = American Physical Therapy Association; DVGS = German Union for Health Exercise and Exercise Therapy; CDC = Centers for Disease Control and Prevention; KNGF = Dutch Royal Society of Physiotherapy; SSO = Society of Surgical Oncology; NCCN = National Comprehensive Cancer Network; CSEP = Canadian Society for Exercise Physiology; NIH = National Institutes of Health; SBM = Society of Behavioral Medicine; ESSA = Exercise and Sport Science Australia; FPMR = Foundation for Physical Medicine and Rehabilitation

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