



Development of the Exercise in Cancer Evaluation and Decision Support (EXCEEDS) algorithm

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Abstract

Purpose Participation in exercise or rehabilitation services is recommended to optimize health, functioning, and well-being across the cancer continuum of care. However, limited knowledge of individual needs and complex decision-making are barriers to connect the *right survivor* to the *right exercise/rehabilitation service* at the *right time*. In this article, we define the levels of exercise/rehabilitation services, provide a conceptual model to improve understanding of individual needs, and describe the development of the Exercise in Cancer Evaluation and Decision Support (EXCEEDS) algorithm.

Methods From literature review, we synthesized defining characteristics of exercise/rehabilitation services and individual characteristics associated with safety and efficacy for each service. We developed a visual model to conceptualize the need for each level of specialized care, then organized individual characteristics into a risk-stratified algorithm. Iterative review with a multidisciplinary expert panel was conducted until consensus was reached on algorithm content and format.

Results We identified eight defining features of the four levels of exercise/rehabilitation services and provide a conceptual model of to guide individualized navigation for each service across the continuum of care. The EXCEEDS algorithm includes a risk-stratified series of eleven dichotomous questions, organized in two sections and ten domains.

Conclusions The EXCEEDS algorithm is an evidence-based decision support tool that provides a common language to describe exercise/rehabilitation services, a practical model to understand individualized needs, and step-by-step decision support guidance. The EXCEEDS algorithm is designed to be used at point of care or point of need by multidisciplinary users, including survivors. Thus, implementation may improve care coordination for cancer exercise/rehabilitation services.

Keywords Cancer · Exercise · Survivorship · Triage · Decision support · Clinical pathway

Introduction

Despite high levels of research evidence [1, 2] and calls to action spanning four decades, knowledge of, access to, and

utilization of exercise and rehabilitation services for cancer survivors remain limited [3]. As a result, inactivity and disability are prevalent and contribute to high rates of long-term cancer-related burden and high health care costs [3, 4].

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Leading researchers and clinical organizations agree survivors should “avoid inactivity,” and they call for oncology clinicians to screen patients and refer to exercise or rehabilitation services based on individual needs [5–8].

Individualized referral to exercise or rehabilitation services is a complex process that requires the ability to understand a survivor’s needs and goals, then rectify with recommendations from numerous sources—often during busy clinical encounters. Heterogeneity in medical status, functional level, and goals throughout the continuum of care play an important role in determining the safest and most efficacious service, and the best-qualified person to supervise and prescribe exercise. For example, survivors having trouble with activities of daily living are likely to benefit most from rehabilitation, while supervised or unsupervised community-based exercise may be more appropriate for those who have few daily restrictions but seek to maintain or improve endurance or fitness. At least 69 oncology clinical practice guidelines include exercise or rehabilitation recommendations to support screening and referral, yet only approximately 20% of oncology are aware of these recommendations [9]. Thus, the practical ability to understand individual needs across the continuum of care and coordinate the *right* exercise or rehabilitation *service*, for *right* survivor, at the *right* time is an ongoing challenge in oncology and survivorship care. International colleagues have specifically called for the development of a practical decision support algorithm to improve knowledge of individual needs and care coordination at point of care or point of need [10].

In this article, we describe the development of the Exercise in Cancer Evaluation and Decision Support (EXCEEDS) algorithm and our next steps for validation and implementation. To promote knowledge and understanding of existing services, we first define the core elements of exercise and rehabilitation services using a stepped care model [11]. To promote a common understanding of survivors’ individualized needs, we provide a conceptual model of cancer-related disability and subsequent need for exercise or rehabilitation services.

Methods

Literature review

We (KC & TM) searched PubMed and MEDLINE databases for articles published in English using key phrases including “neoplasm” or “cancer;” “patient” or “survivor;” “exercise,” “physical activity,” or “rehabilitation;” “medical clearance,” “risk,” or “safety;” “guidelines” or “perspectives;” and “decision making,” or “prescription.” From these searches, we identified and reviewed 49 publications including exercise pre-participation risk-screening recommendations, relevant

peer-reviewed research, and clinical practice or exercise participation guidelines.

Literature synthesis

From each article, we abstracted the following: (1) characteristics used to differentiate each level of stepped care, and (2) criteria associated with the need for pre-exercise medical clearance or need for specialized care (e.g., rehabilitation intervention vs. exercise supervision). We synthesized and grouped characteristics into eight defining features to differentiate four stepped care service levels: cancer rehabilitation; clinically supervised exercise; supervised, cancer-specific community-based exercise; and unsupervised, or generic, community-based exercise (Table 1). Next, we drew upon a multidisciplinary conceptual framework, the International Classification of Disability and Functioning (ICF) [27], to model cancer-related disability and subsequent need for specialized services across the continuum of care (Fig. 1).

Algorithm development

To develop the EXCEEDS algorithm, we synthesized criteria associated with the need (or no need) for pre-exercise medical clearance, then grouped all criteria according to domain (activity level, disease, or symptom). In each domain, we organized criteria by the associated level of risk for exercise-related adverse event. For example, criteria associated with a high level of exercise-related adverse event were grouped together (e.g., angina, shortness of breath, recent injury, or treatment). Next, we synthesized criteria associated with the need for specialized care and aligned each criterion with a level of stepped care as defined in Table 1. Guided by the ICF, we grouped criteria into broad domains (e.g., disease side effects, functional factors, and behavioral factors). Finally, we sorted each domain by decreasing the need for specialized care. For example, cancer-specific side effects associated with a high need for specialized care were grouped together and sorted above domains associated with less specialized care.

Final criteria and stepped care triage recommendations for each domain (Table 2) were established through an iterative consensus-building process with a multidisciplinary team of expert stakeholders representing the following disciplines: exercise physiology, nursing, occupational therapy, psychiatry, physical therapy, behavioral science, medical oncology, and patient-advocacy (G.C., G.W., J.F., T.K., N.H., C.A., & M.P.). Each stakeholder reviewed and provided feedback on the rationale for the proposed criteria and recommendations (pre-exercise medical evaluation and level of stepped care). Based on stakeholder feedback to further differentiate triage recommendations for each level of stepped care, we stratified side effect and functional domains into two levels: Level 2 (i.e., need for rehabilitation) and Level 1 (i.e., need for clinical

Table 1 Defining features of exercise and rehabilitation stepped care services

	Cancer rehabilitation	Clinically supervised exercise	Supervised, cancer-specific community-based	Generic or unsupervised community-based
Level of care [11]	“Impairment-driven care, complicated”	“Impairment-directed care, uncomplicated”	“General conditioning activities, specialized”	“General conditioning, unspecified”
Delivery personnel (minimum requirements) [5, 11–17]	Rehabilitation clinician(s) with cancer-specific training or experience/master’s-level clinical degree (minimum) and board certification. May include occupational or physical therapist, physiatrist, speech and language pathologist, nurse, certified lymphedema specialist. ^a	Exercise clinician with a master’s-level degree and relevant clinical certification (preferably cancer-specific) ^{b,c} or training. Supervision or evaluation may be led by rehabilitation therapist, or other clinician(s). ^a	Exercise professional(s) with a bachelor’s-level degree in exercise physiology (or related field), relevant certification(s) from ACSM ^d (or comparable organization), and cancer-specific certification or training.	Generic: exercise professional(s) with high school degree and site-required certification. Unsupervised: exercise prescription/support may be provided by 3 rd party via asynchronous platform (educational resource, peer support, mobile application, etc.)
Facility [5, 12–15]	Outpatient rehabilitation clinic	Outpatient location; typically affiliated with university, cancer center or other medical clinic	Community sites, not typically affiliated with medical institution	Home-based or any community-based setting
Focus of service [5, 11, 12, 14, 16]	Interdisciplinary assessment and therapeutic exercise to address specific clinical outcomes (i.e., impairment, functional limitations, side effects)	Discipline-specific assessment and intervention to address specific clinical outcomes	Individualized and supervised exercise prescription or instruction including aerobic, resistance, flexibility and balance/coordination exercise	Guideline concordant physical activity and improved fitness ^e
Goals of service [12, 13, 15, 16, 18–20]	<ul style="list-style-type: none"> Short term: improve physical function (ability to complete daily activities), reduce symptom burden, maximize independence and improve QOL. Improve exercise knowledge via education. Long-term: enhanced functional status and quality of life to support transition to less specialized service. 	<ul style="list-style-type: none"> Short term: improve fitness, participation in life activities, physical activity level and exercise self-efficacy; symptom management; improve exercise knowledge and expectations via education and reflection. Long-term: ability to self-monitor during exercise and set/achieve exercise goals. Transition to less specialized service. 	<ul style="list-style-type: none"> Short term: improve fitness, ability to complete ADL’s/IADLS, and self-efficacy. Minimize exercise barriers. Find enjoyable types/modalities of exercise. Long-term: transition to unsupervised, build guideline-accordant physical activity/exercise habits.^e 	<ul style="list-style-type: none"> Short term: continue to improve fitness, function, exercise self-efficacy and QOL. Reduce barriers associated with center-based exercise Long term: maintain or enhance guideline-accordant physical activity/exercise habits.^e
Cost/funding [12, 13, 16, 21, 22]	<ul style="list-style-type: none"> Services covered by most 3rd party payers; may be subject to patient copayments and payer medical necessity criteria. 	<ul style="list-style-type: none"> Not typically subsidized by 3rd party payers. May be offered at no additional charge to the patient in some cancer care settings. 	<ul style="list-style-type: none"> Not typically subsidized by 3rd party payers. May be subsidized alternatively (e.g., workplace wellness, scholarships or donations) 	<ul style="list-style-type: none"> Not typically subsidized by 3rd party payers (except Silver Sneakers). May be subsidized alternatively.
Caveats [13, 16, 23]	<ul style="list-style-type: none"> Limited availability or accessibility due to costs, location, 3rd party reimbursement, etc. Likely not reimbursable for survivors without diagnosable impairments Insufficient workforce of rehabilitation clinicians with cancer specific training Growing, but limited evidence of efficacy and effectiveness 	<ul style="list-style-type: none"> Limited accessibility and reimbursement Challenging for health care providers to recognize need and make referral Insufficient workforce of clinicians with cancer-specific training Cost for services may be high Services may not be cancer-specific (e.g., combined with cardiac rehabilitation or other services) Growing, but limited evidence of efficacy and effectiveness Recommended [20], but lack of agreed upon and mandated minimal standards for implementation 	<ul style="list-style-type: none"> Limited availability or accessibility due to cost, location, 3rd party reimbursement, etc. (especially in rural areas) Lack of sustainable funding model and program accreditation standards Insufficient workforce of exercise professionals with cancer-specific training Services vary in eligibility criteria, participant fees, design, Content and ability to provide specialized care. Growing, but limited evidence of effectiveness 	<ul style="list-style-type: none"> May increase risk of exercise-related adverse event for those with more serious health conditions or those at risk for moderate-to-severe cancer treatment-related impairments Generic exercise programs and self-guided resources are widely available but rarely evidence-based or delivered with clinical expertise Individuals must be motivated to maintain activity and seek out/use additional resources (i.e., high self-efficacy)
General patient qualifiers (synthesized from literature)	<ul style="list-style-type: none"> Presence (or signs/symptoms) of a health condition that indicates high risk for exercise-related adverse event, or need for specialized rehabilitation care (e.g., difficultly managing 	<ul style="list-style-type: none"> Presence (or signs/symptoms) of a health condition that indicates moderate risk for an exercise-related adverse during unsupervised exercise, or need for specialized clinical care 	<ul style="list-style-type: none"> No health condition (or signs/symptoms) that indicate greater than low risk of an exercise-related adverse during supervised exercise, or need for 	<ul style="list-style-type: none"> No health condition (or signs/symptoms) that indicate greater than low risk of an exercise-related adverse during unsupervised exercise High exercise self-efficacy

Table 1 (continued)

	Cancer rehabilitation	Clinically supervised exercise	Supervised, cancer-specific community-based	Generic or unsupervised community-based
review) [5, 17, 24–26]	lymphedema; lung/bone/brain diagnosis or metastasis) <ul style="list-style-type: none"> ▪ Inability to complete most ADL/IADL independently ▪ Functional limitations or conditions that require a specialized rehabilitation program to address specific needs (e.g., ataxia, surgical restrictions, severe pain or fatigue, myopathy) 	during exercise (e.g., weakened immune system, bowel or gastrointestinal issues, history of falls) <ul style="list-style-type: none"> ▪ Difficulty completing some ADL independently ▪ Functional limitations or conditions that require clinical supervision and/or professional exercise guideline to address specific needs (e.g., impaired balance due to neuropathy, mild fatigue, managing treatment side effects) 	specialized clinical care during exercise <ul style="list-style-type: none"> ▪ Presence of a catheter ▪ Low exercise self-efficacy ▪ May have completed cancer rehabilitation or clinically-supervised intervention 	<ul style="list-style-type: none"> ▪ May have completed cancer rehabilitation, clinically-supervised intervention, or community-based

Note: ACSM American College of Sports Medicine (ACSM), *QOL* Quality of Life, *IADL* Instrumental Activity of Daily Living, *ADL* Activity of Daily Living

^a Other rehabilitation clinicians include dietician/nutrition, psychology, social work, lymphedema, or pelvic floor specialists

^b Certifications: Clinical Exercise Physiologist (CEP; <https://www.acsm.org/get-stay-certified/get-certified/cep>) or Registered Clinical Exercise Physiologist

^c Certification: ACSM/American Cancer Society Cancer Exercise Specialist (<https://www.acsm.org/get-stay-certified/get-certified/specialization/cet>)

^d Certifications: Exercise Physiologist (<https://www.acsm.org/get-stay-certified/get-certified/health-fitness-certifications/exercise-physiologist>), Personal Trainer (<https://www.acsm.org/get-stay-certified/get-certified/health-fitness-certifications/personal-trainer>), Group Exercise Instructor (<https://www.acsm.org/get-stay-certified/get-certified/health-fitness-certifications/gei>)

^e ACSM Exercise Guidelines for Cancer Survivors [26]

supervision). In these domains, all criteria associated with the need for rehabilitation vs. clinically supervised exercise were categorized as “Level 2” vs. “Level 1.” For example, fatigue is a common side effect of cancer treatment. Our literature review indicates cancer rehabilitation is the most appropriate level of service for survivor’s with moderate-to-high levels of fatigue interfering with daily activities (i.e., Level 2), while those with mild or controlled fatigue (i.e., Level 1) are likely to benefit equally from clinically supervised exercise, or unsupervised exercise if they have no additional risk factors. Through ongoing consultation with reviewed literature and among the stakeholder team, we refined the EXCEEDS algorithm until stakeholder consensus was reached for all algorithm factors and triage recommendations.

Results

Defining characteristics of exercise and rehabilitation stepped care services

Using a stepped care framework, exercise and rehabilitation services recommended for cancer survivors include four levels (from the highest specialized care to the lowest): cancer rehabilitation; clinically supervised exercise; supervised, cancer-specific community-based exercise; and unsupervised, or

generic, community-based exercise [11, 12]. Table 1 summarizes characteristics that differentiate each level of stepped care including the following: level of care as described previously by Alfano and colleagues [11], minimum requirements of delivery personnel, facility characteristics, focus of service, short- and long-term goals of service, cost and functioning considerations, caveats, and general patient qualifiers synthesized during our literature review.

Conceptual model of the multidimensional factors that influence stepped care needs

Guided by the International Classification of Function, Disability and Health (ICF) [27], and the work of Alfano and Pergolotti [], Fig. 1 depicts the multidimensional factors that can influence a survivor’s need for exercise or rehabilitation stepped care services at any point along the continuum of care. Throughout the continuum of care, ICF factors interact to increase or decrease the risk of exercise-related adverse events and the need for specialized care (Fig. 1). For example, the negative effects of radiation on body structures and function increase the risk for exercise-related adverse event, and may lead to activity restriction without rehabilitation intervention. Accordingly, the EXCEEDS algorithm is designed to be used at any time to guide triage decision-making based on an

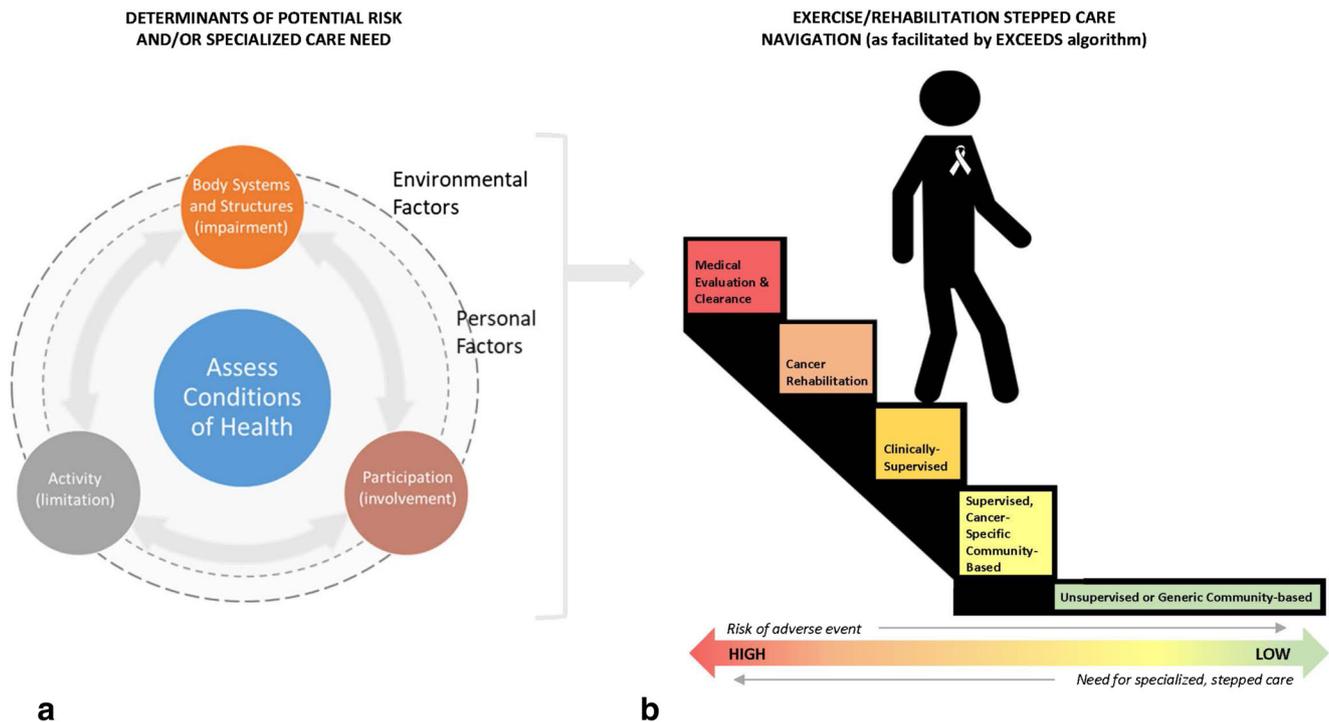


Fig. 1 EXCEEDS Algorithm Conceptual Model. Appropriate navigation of the levels of exercise and rehabilitation stepped care (b) is a function of multidimensional factors (a), described previously by the International Classification of Function, Disability and Health

individual's risk of exercise-related adverse events and need for specialized care.

The EXCEEDS algorithm

The EXCEEDS algorithm is a two-part tool designed to identify exercise-related risk and provide appropriate triage recommendations. In the EXCEEDS algorithm, risk-stratified branching logic is used in each section and domain to minimize the amount of information necessary to make medical clearance and triage recommendations. Figure 2 illustrates the EXCEEDS algorithm flow chart. Survivors should be re-evaluated at each stage of the continuum of care [40] as part of prospective surveillance [41, 42] and in the presence of any adverse event, change in health status, or exercise motivation.

Section 1 of the algorithm includes three domains (Physical Activity Level, Presence of Chronic Disease, and Medical Follow-Up) that determine need, or no need, for pre-participation medical clearance. Pre-exercise medical clearance is indicated only for individuals who are insufficiently active (i.e., <30 minutes moderate intensity exercise, 3× per week for 3 months [29]) and answer yes to any question in the chronic disease or medical follow-up domains. Section 2 includes seven domains: cancer-specific factors, functional factors (level 1 and 2), side effects (level 1 and 2), presence of catheter, and exercise self-efficacy. Stop logic is used in each domain to immediately provide a recommendation when a

[27], and Alfano and Pergolotti [28]. Throughout the continuum of care these factors interact to increase or decrease risk of exercise-related adverse event and need for specialized care. Figure (a) used with permission from Alfano and Pergolotti [28].

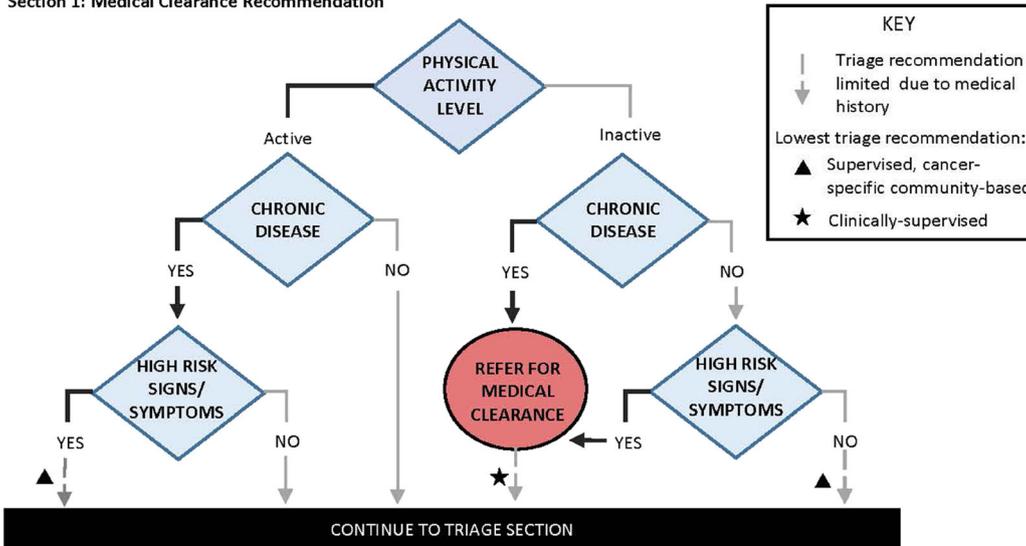
risk/specialized care need is identified. For example, if a survivor answers yes to any question in the cancer-specific factors domain, referral to cancer rehabilitation is immediately recommended and no additional questions are prompted. Table 2 provides additional detail on the criteria and references for each domain.

Justification of Triage Recommendations for Each Stepped Care Level: Highest Specialized to Lowest

Cancer rehabilitation

Cancer rehabilitation services are delivered by licensed healthcare professionals with expertise in therapeutic interventions to maintain or restore function, reduce symptom burden, improve quality of life, and maximize independence by improving a survivor's ability to participate fully in work, leisure, and other life roles [11,]. Randomized trials and practice-based evidence have demonstrated many of these benefits throughout the continuum of care, including enhanced physical health or functioning [43, 44], reduced symptom burden [44], and enhanced quality of life and participation [23, 44–46]. Physical and occupational therapists (PT/OT) are the primary recipients of triage recommendations from the EXCEEDS algorithm due to the exercise-related

Section 1: Medical Clearance Recommendation



Section 2: Triage Recommendation

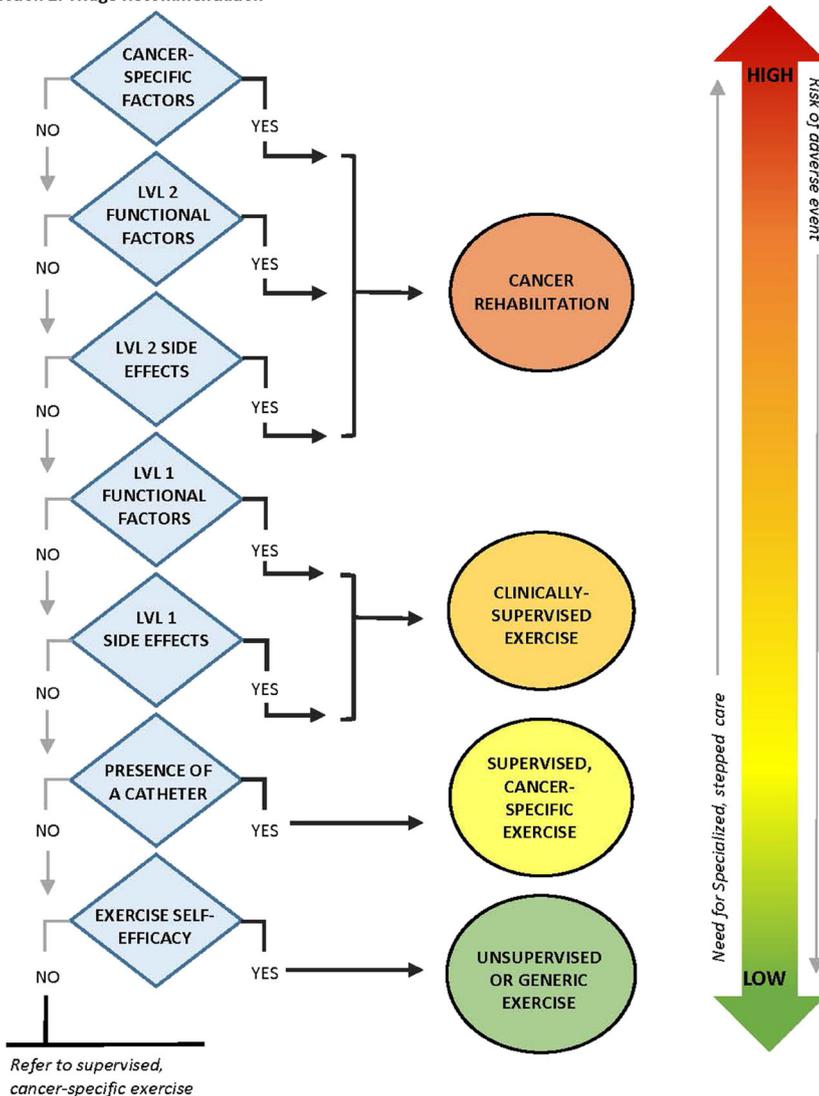


Fig 2 The EXCEEDS algorithm flow chart diagram

Table 2 The EXCEEDS algorithm domains, criteria, and supporting references

Algorithm domain	Criteria	Reference(s)
Section 1: medical clearance recommendation		
Physical activity level	Yes or no: currently meeting exercise guidelines (Guidelines: ≥ 30 minutes of moderate intensity exercise on ≥ 3 days per week for ≥ 3 months) ^a	<ul style="list-style-type: none"> American College of Sports Medicine guidelines for exercise testing and prescription [29] ActivOnco Model [30]
Chronic disease	<p>Yes or no: presence of ≥ 1 chronic disease or related complications, including the following:</p> <ul style="list-style-type: none"> Heart failure Kidney failure (or other renal disease) Diabetes Metastatic cancer to bones or brain, or another major organ Unstable angina Dizziness resulting in loss of balance or consciousness Major surgery with restrictions in past 3 months History of cardio toxic treatment <p>Yes or no: new, worsening or difficulty managing any of the following conditions: lymphedema, ostomy, significant weight fluctuations, infection, ataxia, malnourishment, severe fatigue, bone/back/neck pain and unusual weakness</p>	<ul style="list-style-type: none"> Physical Activity Readiness Questionnaire (PAR-Q) [31] American College of Sports Medicine guidelines for exercise testing and prescription [29] Cancer-specific exercise risk screening tool [32] National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 (National Comprehensive Cancer Network, 2020) [33] Macmillan Cancer Rehabilitation pathways [34] ActivOnco Model [30] Macmillan Cancer Rehabilitation pathways [34]
High-risk signs/- symptoms	<p>Yes or no: presence of ≥ 1 complication or high-risk signs/symptoms associated with the following diseases:</p> <ul style="list-style-type: none"> Cardiovascular or respiratory disease Previous stroke, neurological condition, or spinal cord injury Musculoskeletal injury or degenerative conditions Recent steroid injection and potential for steroid-induced myopathy Uncontrolled diabetes mellitus 	<ul style="list-style-type: none"> Physical Activity Readiness Questionnaire (PAR-Q) [31] National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33] Macmillan Cancer Rehabilitation pathways [34] Cancer-specific exercise risk screening tool [32] ActivOnco Model [30]
Section 2: triage recommendations		
Cancer-specific factors	<p>Yes or no, presence of ≥ 1 of the following factors:</p> <ul style="list-style-type: none"> Cancer type (head and neck, lung myeloma, sarcoma, or metastasis to bones, brain, or other organ) Fracture risk or severe osteoporosis or osteopenia History of blood clot, deep vein thrombosis, or pulmonary embolism Lymphedema high risk or difficulty managing 	<ul style="list-style-type: none"> ActivOnco Model [30] Macmillan Cancer Rehabilitation pathways [34] National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33] Focused review of safety considerations in cancer rehab [25] The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14]
Level 2 functional factors	<p>Yes or no, presence of ≥ 1 of the following factors:</p> <ul style="list-style-type: none"> Mobility aid required to complete daily activities Able to mobilize 1 block of less Limited upper extremity range of motion ADL or IADL dependency Moderate-severe general mobility pain (hip knee, back, etc.) Ataxia or unusual weakness Moderate cognitive declines that impair function Peripheral neuropathy that is painful or limits function 	<ul style="list-style-type: none"> National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33] National Comprehensive Cancer Network (NCCN): Older Adult Oncology Clinical Practice Guidelines V1.2019 [35] Exercise in Medicine in Oncology: ACSM 2019 Roundtable [5] Macmillan Cancer Rehabilitation pathways [34] ActivOnco Model [30] Cancer-specific exercise risk screening tool [32] Association of Clinical Oncology (ASCO) Management of Older Adults Guideline [36] The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14] International Society of Geriatric Oncology (SIOG) recommendations for management of cancer-related cognitive decline [37]
Level 2 side effects	<p>Yes or no, presence of ≥ 1 of the following factors:</p> <ul style="list-style-type: none"> Moderate to severe fatigue (4+) Neurological symptoms (dizziness/lightheaded; disorientation) Blurred vision Dyspnea 	<ul style="list-style-type: none"> Macmillan Cancer Rehabilitation pathways [34] ActivOnco Model [30] The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14]
Level 1 functional factors	<p>Yes or no, presence of ≥ 1 of the following factors:</p> <ul style="list-style-type: none"> Fall in previous six months Other mobility issues, including: decreased balance, decreased gait speed, mild bodily pain when moving, difficulty with ADL/IADL 	<ul style="list-style-type: none"> Macmillan Cancer Rehabilitation pathways [34] Association of Clinical Oncology (ASCO) Management of Older Adults Guideline [36] Cancer and Aging Research Group Fall Risk Model [38] Exercise in Medicine in Oncology: ACSM 2019 Roundtable [5]

Table 2 (continued)

Algorithm domain	Criteria	Reference(s)
Level 1 side effects	Yes or no, presence of ≥ 1 of the following factors: <ul style="list-style-type: none"> •Active treatment or surgery in past 3 months •Treatment side effects, including the following: <ul style="list-style-type: none"> ▪Daily mild fatigue ▪Mild neuropathy ▪Occasional cognitive difficulty ▪Orthostatic hypotension •Gastrointestinal (severe nausea; vomiting/diarrhea; dehydration; inadequate food/fluid intake) •Urinary or fecal incontinence •Managed lymphedema •Weakened immune system: thrombocytopenia (low platelets), anemia (low hemoglobin), or neutropenia (low white blood cell count) 	<ul style="list-style-type: none"> •The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14] •The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14] •Macmillan Cancer Rehabilitation pathways [34] •ActivOnco Model [30] •National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33]
Presence of a catheter	Yes or no, current or planned upcoming presence of catheter (including but not limited to: peripherally inserted central catheter (PICC), intraperitoneal catheter, or ostomy)	<ul style="list-style-type: none"> •National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33] •Macmillan Cancer Rehabilitation pathways [34]
Exercise self-efficacy	Yes or no, high confidence in ability to exercise at least 3 times per week for at least 30 minutes per day over the next 3 months without support from an exercise professional.	<ul style="list-style-type: none"> •Macmillan Cancer Rehabilitation pathways [34] •National Comprehensive Cancer Network (NCCN): Survivorship Clinical Practice Guidelines V1.2020 [33] •The Interdisciplinary Rehabilitation Care Team and the Role of Physical Therapy in Survivor Exercise [14]

^a Measure: Physical Activity Vital Sign (PAVS) [39]

nature of the tool and fall within the PT/OT scope of practice. However, additional members of the cancer rehabilitation team are included in Table 1, because many survivors will have needs outside the PT/OT scope of practice. Using the EXCEEDS algorithm triage to cancer rehabilitation is recommended for all individuals who have one cancer-specific factor, one level 2 functional factor, or one level 2 side effect.

Clinically supervised exercise services

Clinically supervised exercise services may be a pragmatic and accessible supplement to cancer rehabilitation for some individuals with comorbidities (e.g., a survivor with cardiac instability but no other functional limitations) or for those with limited accessibility to rehabilitation for geographic or financial reasons (e.g., no local cancer-specific rehabilitation clinicians, no or limited insurance, or high out-of-pocket costs). Intervention is typically led by an exercise clinician with oversight from a rehabilitation or other clinical specialist including nursing. Although the effectiveness of these programs has not been reviewed exclusively, many studies have demonstrated positive effects and impacts for cancer survivors, including decreased fatigue [47–49] and improved function [47, 48, 50, 51], quality of life [48], symptom management [51], fitness [48], physical activity level [49], and health-care

utilization [51]. However, we recommend a minimum requirement of an evaluation by a qualified cancer rehabilitation practitioner prior to initiating exercise programs to ensure the survivor's safety and maximum benefit. Clinically supervised exercise is the minimum level of care recommended for individuals who are currently inactive and who have at least one response in the chronic disease or medical follow-up domains. Using Section 2 of the EXCEEDS algorithm, we recommend triage to clinically supervised exercise for individuals with one level 1 functional factor or one level 1 side effect.

Supervised, cancer-specific community-based exercise

Many cancer-specific and supervised programs exist across the US (Table 1), and the American College of Sports Medicine (ACSM) has recently led efforts to consolidate information about these programs into a publicly available database for clinician and individual use. The reach, effectiveness, implementation, impact (on quality of life), and maintenance of cancer-specific community-based programs have been recently summarized [13]. In general, these programs are safe and effective to improve quality of life [13, 52] and physical function [53]. Many individual programs have demonstrated improvements in cancer-specific outcomes [54, 55]

and long-term sustainability [49, 56–59], including the Livestrong® at the YMCA program [57], which was available in 791 YMCAs across the US (April 2020).¹ Supervised, cancer-specific community-based exercise is the minimum level of care recommended for individuals who are currently active and have a positive response in the medical follow-up domain. Using Section 2 of the EXCEEDS algorithm, we recommend that individuals who either have a catheter (National Comprehensive Cancer Network guidelines [24]) or have low exercise self-efficacy² should be triaged to supervised, cancer-specific community-based exercise interventions.

Unsupervised or generic, community-based exercise

Unsupervised community-based exercise includes self-directed exercise in any setting, often community- or home-based. We include generic (i.e., non-cancer specific) community-based services in this category because they lack cancer-specific supervision. Generic exercise includes traditional fitness classes, SilverSneakers®, worksite wellness, and personal training with a non-specialized trainer. Evidence suggests that supervised exercise is superior to unsupervised exercise for cancer survivors [60]; therefore, we have based triage recommendations on a survivor's level of exercise self-efficacy. Although home-based exercise is often preferred by survivors [61–63], research has demonstrated mixed effects on function, cancer-specific outcomes, and quality of life [53, 64, 65]. Recommendations for home-based exercise should be made with caution, based on the needs of the survivor, and accompanied by personal support and local resources. The EXCEEDS algorithm recommends that individuals with high exercise self-efficacy and no other concerns can start or continue independent or generic community-based exercise. Survivors may be encouraged to participate in independent or generic community-based exercise as a complement to specialized services at the discretion of the appropriate rehabilitation or exercise professional.

Discussion

The EXCEEDS algorithm is an innovative tool that can be used at a point of care or point of need to determine the safest and most efficacious exercise and rehabilitation interventions and facilitate patient-centered referrals in alignment with

current recommendations. Through our collaborative development effort led by multidisciplinary stakeholders, we have closed critical gaps, enhanced clinical decision-making, and integrated exercise and rehabilitation into a routine component of cancer care. To maximize the utility and adaptability of the EXCEEDS algorithm, we combined risk stratification³ and health-care need decision-making processes⁴ [41] into one step-by-step evidence-based decision-making process. Watson et al. (2012) [41, 42] previously emphasized the importance of this dual approach for surveillance during cancer survivorship and provided a prospective surveillance framework to guide the timing of evaluation that can be integrated into clinical pathways [8].

Limitations and next steps

This manuscript presents the current version of the EXCEEDS algorithm; the tool is not yet widely available, and additional research and validation are required prior to widespread dissemination. A Delphi study is underway (2020) by three authors (K.C., M.P., T.M.) to gain consensus for the EXCEEDS algorithm's acceptability and strategic implementation, including needs for adaptation and integration with existing digital and clinical platforms. The development team will adapt the EXCEEDS algorithm using an iterative process similar to the one described earlier. Finally, validation and clinical implementation effectiveness trials of the algorithm will be formulated, based on results from the Delphi study. The sensitivity and specificity of the algorithm will be determined through comparison to current recommendations. We plan to test the efficacy of the algorithm retrospectively in a large clinical registry sample and compare EXCEEDS algorithm recommendations to those made by the ACSM and PAR-Q collaboration [66–68]. Although beyond the scope of this article, additional work is needed to further understand the role of various types of supervision, such as indirect or direct supervision and synchronous or asynchronous virtual platforms.

Conclusion

The EXCEEDS algorithm is designed to address current barriers to exercise and rehabilitation care coordination by providing a common language to understand and differentiate levels of care, a practical model to conceptualize individualized needs, and an evidence-based guide to support point of care or point of need decision-making. Implementation of the

¹ <https://www.livestrong.org/what-we-do/program/livestrong-at-the-ymca>

² Exercise self-efficacy as defined in the EXCEEDS tool is an individual's level of confidence in their ability to perform moderate intensity exercise at least 30 minutes per day, at least three times per week, for three months.

³ Risk stratification is “the process of quantifying the probability of a harmful effect to individuals resulting from a range of internal and external factors.”[41]

⁴ Health-care need is “the capacity to benefit from health care” [41]

final version of the EXCEEDS algorithm is planned for both clinician-facing and survivor-facing platforms, including electronic medical records, patient portals, smartphone applications, and print materials. Thus, implementation of the EXCEEDS algorithm has the potential to optimize survivorship care through improved ability to connect the *right survivor*, to the *right service*, at the *right time*.

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Data availability Not applicable.

Declarations

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