Wearable Monitors Facilitate Exercise in Adult and Pediatric Stem Cell Transplant

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1Department of Health and Human Physiology, 2Department of Internal Medicine, Division Hematology, Oncology, and Bone Marrow Transplant, 3Holden Comprehensive Cancer Center, 4Divisions of Hematology-Oncology, and 5Neonatology, Stead Family Department of Pediatrics, University of Iowa, Iowa City, IA

POTTEBAUM, E., A. WARMOTH, S. AYYAPPAN, D.S. DICKENS, Y. JETHAVA, A. MODI, M.H.. TOMASSON, L.J. CARR, and M.L. BATES. Wearable monitors facilitate exercise in adult and pediatric stem cell transplant. Exerc. Sport Sci. Rev., Vol. 49, No. 3, pp. 205–212, 2021. Hematopoietic stem cell transplant (HSCT) is a potentially curative treatment for hematopoietic malignancies, complicated by decreased performance status and quality of life. Exercise therapy improves outcomes in HSCT, but several barriers have prevented exercise from becoming routine clinical practice. Based on existing data that wearable technologies facilitate exercise participation in other sedentary and chronic illness populations, we propose the novel hypothesis that wearable technologies are a valuable tool in transcending barriers and developing exercise therapy programs for HSCT patients. Key Words: hematopoietic stem cell transplantation, wearable technology, exercise interventions, physical activity, oncology practice

Key Points

- Hematopoietic stem cell transplantation (HSCT) is an intensive treatment for blood cancers that results in loss of performance and decreases in quality of life.
- Exercise intervention throughout HSCT is a safe and effective method to prevent loss in physical performance and improve clinical outcomes in patients.
- Wearable technology facilitates exercise interventions in other populations, such as sedentary adults.
- The integration of wearable technology into HSCT care could provide a framework for individualized exercise prescriptions that improve patient outcomes.

INTRODUCTION

Hematopoietic stem cell transplantation (HSCT) is the only potentially curative therapy for many adult and pediatric patients with hematological cancers. The clinical journey of the HSCT patient includes induction chemotherapy, the initial treatment of the blood cancer, lower-dose consolidation chemotherapy cycles, HSCT consisting of a conditioning regimen to further reduce tumor burden and prepare the bone marrow for engraftment, and transplantation with the patient’s own (autologous) or a donor’s (allogenic) stem cells. Even patients that survive the procedure and are cured of their cancer face a highly variable survivorship period. Some patients receive more than one HSCT for the treatment of their disease. Each step of the HSCT process is associated with increased sedentary time and sequelae including depression and fatigue, muscle atrophy, decreased strength and flexibility, prolonged immune suppression, and anxiety. Long-term, posttreatment outcomes of HSCT include fatigue and depression, graft-versus-host disease, and cardiac toxicity. These can be debilitating and prevent patients from fully “returning to normal” (1). As we discuss here, evidence supports exercise as an effective adjuvant treatment to HSCT, why is it not standard of care?

Addressing barriers to exercise in HSCT is central to answering this question. Wearable activity monitors have been used as an intervention tool to support individualized exercise interventions for patients with chronic diseases. However, to date, wearable activity monitors have not been used to support exercise therapy in HSCT. In this article, we assess the safety and feasibility of exercise in HSCT patients of all ages, the potential application of wearable activity monitors for supporting exercise in HSCT patients, the benefits and pitfalls of wearable activity monitors, and future directions needed to implement this model into clinical care. Based on existing data that wearable technologies facilitate exercise participation in other sedentary
(2) and chronic illness populations (3), we propose the novel hypothesis that wearable technologies are a valuable tool in transcending barriers and developing exercise therapy programs for HSCT patients (Fig. 1).

WEARABLE ACTIVITY MONITORS
Wearable activity monitors include wristbands, smartwatches, smartphones, and smart textiles. They are capable of estimating energy expenditure, heart rate, sleep patterns, and physical activity using integrated pedometers or accelerometers (4). Wearable technology is a dynamic field, and new applications and features continue to be developed. Wrist-worn devices and watches have been used effectively in children, adults, and the elderly. From an intervention standpoint, wearable activity monitors are most commonly used to support behavior change techniques in the form of goal setting and self-monitoring progress toward goals (5). They can interact with smartphone applications, which integrate social support and reinforcement, allowing users to share progress with others through social media platforms (4,6). Nearly a quarter of U.S. adults report currently using a wearable activity monitor, and 76.3% are willing to share physical activity data with their health care providers (7). A study of two common wrist-worn activity monitors found that they are accurate in measuring heart rate and estimating energy expenditure during low- to moderate-intensity exercise (4).

Indeed, the accuracy of wearable activity monitors has been extensively evaluated, and users should carefully consider the modality of exercise and primary end point in determining the monitor that is most appropriate for their needs (8). For example, wrist-worn monitors that report “steps” as the primary output of physical activity may not be appropriate for individuals engaged in activities with minimal arm movement (e.g., cycling or recumbent elliptical trainers).

SAFETY AND FEASIBILITY OF EXERCISE IN ADULT AND PEDIATRIC HSCT PATIENTS
The American College of Sports Medicine (ACSM) has published exercise prescription guidelines that include frequency, intensity, type, and time recommendations for adult patients with cancer that largely mirror the exercise recommendations for the general population (9): aerobic training three to five times per week and resistance training two to three times per week. The ACSM guidelines include special considerations for adult HSCT patients including starting at a lighter intensity and lower progression of intensity in the setting of fatigue, training at home or in a medical facility when immunosuppressed, and emphasizing that resistance training may be more beneficial than aerobic training in combating the muscle wasting consequences of HSCT (10). Although there are no guidelines for pediatric patients, it is important to include a discussion of this population.

**Figure 1.** Hypothesized role for wearable technology in exercise prescription for HSCT patients. Hypothesized integration points for wearable technology are shown in red. In current practice, oncology providers develop exercise prescriptions for HSCT patients, whose implementation may be limited by barriers to exercise. Wearable technology may be useful in addressing these barriers and in providing feedback to providers. This may allow providers to better refine exercise prescriptions. Wearable technology may be useful at all stages of patient care, including cancer prevention, inpatient and outpatient treatment, and survivorship.
There are outstanding data to support a role for exercise in pediatric HSCT patients, but the adolescent patient population has lagged in benefiting from clinical advances (11) and there are unique barriers to clinical research in pediatrics (12) that may prevent the timely translation of new research.

**Adult HSCT Patients**

Each step of the HSCT process, from prevention to survivorship, is potentially amenable to exercise interventions (Fig. 2). The following clinical benefits of exercise in adult HSCT patients (18–65 yr old) are supported by rigorous clinical research studies, including randomized, controlled trials ([13] and reviewed in [14]):

- Increased hemoglobin and decreased creatinine during transplant
- Decreased fatigue and loss of functional performance
- Decreased anger, anxiety, global distress, and hostility
- Decreased somatization, increased physical well-being, and increased walking distance and speed
- Decreased total mortality in HSCT and nonrelapse mortality
- Increased quality of life (QOL) score and increased muscle strength.

In a single study, exercise decreased the length of stay in hospital from 16 ± 4 to 13 ± 3 d (15). Shortening length of stay is good for patients and provides a potential pathway to financial sustainability for exercise programs for HSCT patients. Health care insurers in the United States reimburse HSCT as a single reimbursement (16), so the decreasing length of stay provides cost savings for providers.

Although reports of adverse events with exercise in HSCT patients are low [e.g., (17)], even in patients performing high-intensity exercise (18), exercise prescriptions should be tailored to maximize benefit and minimize risk (19). Special considerations relevant to HSCT patients include severe thrombocytopenia, severe neutropenia, fever and infection, and severe anemia (20). In the setting of neutropenia, exercise at home or in a medical facility may be preferable to community-based interventions. Some HSCT patients, such as those with multiple myeloma, may have osteolytic bone lesions that increase the risk of fracture. Bone loss is exacerbated by prolonged steroid use. Clinicians need to identify and consider these unique clinical circumstances. However, being overly conservative with exercise prescription may be detrimental.

Comparing with the pediatric and adult populations (18–65 yr), there are fewer randomized intervention studies in older HSCT patients (>65 yr old). Older adults face a unique set of barriers to exercise, even without a cancer diagnosis. These include decreased strength and aerobic performance that may deter participation in exercise therapy and the belief that exercise will cause pain, injury, or exacerbation of previous ailments (21). These barriers are reflected in trials in the older HSCT population. Schuler et al. (22) evaluated feasibility as a primary end point, and patient strength, endurance, and QOL as secondary end points. The original exercise prescription included aerobic exercise at 75% of the lactate threshold. Patients found this to be unsustainable, and the workload was lowered to 50% of the lactate threshold. Adherence to this revised prescription was similar to that observed in younger HSCT patients (85%) with no reported adverse events. This supports the safety and feasibility of exercise in elderly HSCT patients and highlights the potential need for exercise prescriptions that start at a lower intensity.

**Pediatric HSCT Patients**

Although there are currently no physical activity guidelines for children and adolescents with cancer, data from 13 interventional trials provide strong evidence that exercise interventions improve strength and cardiorespiratory fitness in pediatric HSCT patients (23). Physical activity guidelines for healthy children and adolescents (6–17 yr of age) recommend 60 min·d−1 of moderate-to-vigorous intensity aerobic exercise with resistance training and bone-loading exercises on 3 d·wk−1 (24). Improvements in strength are due to neuromuscular adaptations in prepubertal children (25) and a combination of neural adaptations and muscle hypertrophy in postpubertal children. Exercise interventions aimed at inducing muscle hypertrophy in prepubertal children are not recommended (26).

Pediatric patients undergoing HSCT face a set of unique barriers to normal exercise. Active play can be more effective than structured interventions to increase physical activity in children (27), but pediatric HSCT patients are often isolated and immunosuppressed and may only have access to smaller, designated areas to play or exercise while admitted in the hospital for extended periods. Feasibility studies conclude that intrahospital exercise interventions for pediatric HSCT patients are both feasible and safe (28,29) with no reported adverse events.

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**Figure 2.** Targets for intervention in HSCT. Targets for improvement are given for each stage of the cancer treatment process. *Target that may theoretically benefit from exercise prescription. More study is needed in these areas.**

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**Table 1.** Targets for Exercise Intervention in Hematopoietic Stem Cell Transplant Patients

<table>
<thead>
<tr>
<th>Prevention</th>
<th>Pre-Transplant</th>
<th>Stem Cell Transplant</th>
<th>Survivorship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
<td>Performance Status*</td>
<td>Neutropenia</td>
<td>Cardiac Toxicity*</td>
</tr>
<tr>
<td>Inflammation*</td>
<td>Frailty*</td>
<td>Thrombocytopenia</td>
<td>Fatigue</td>
</tr>
<tr>
<td>Cardiometabolic Disease*</td>
<td>Performance Status</td>
<td>Fatigue</td>
<td>Quality of Life</td>
</tr>
<tr>
<td></td>
<td>Emotional Distress</td>
<td>Somatization</td>
<td>Strength and Fitness</td>
</tr>
<tr>
<td></td>
<td>Somatization</td>
<td>Muscle Atrophy</td>
<td>Independence*</td>
</tr>
<tr>
<td></td>
<td>Deconditioning</td>
<td>Quality of Life</td>
<td>Return to Employment*</td>
</tr>
<tr>
<td></td>
<td>Quality of Life</td>
<td></td>
<td>Non-Relapse Mortality</td>
</tr>
</tbody>
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WEARABLE-BASED INTERVENTIONS AND BARRIERS TO EXERCISE

A cancer diagnosis provides a unique opportunity for behavior modification and the establishment of new exercise habits (30). We hypothesize that wearable activity monitors are useful in translating interventions from the research setting to clinical standard of care. Wearable devices can be used to self-monitor physical activity and progress toward physical activity–related goals throughout a patient’s journey, including prevention, HSCT, and survivorship (Fig. 2). Wearable activity monitors can provide clinicians with important physical activity data that can then be used to inform individualized exercise interventions for patients with blood cancer. Barriers preventing HSCT patients from being physically active include symptoms and side effects of disease and treatment, concerns about the intensity of the exercise prescription, lack of transportation to an exercise clinic or treatment center, and the cost of a rehabilitation program or clinic (31). More than half of patients experience chronic fatigue 6 months after transplantation (32). Sixty-six percent of rural counties in the United States do not have a practicing oncologist, meaning that more than 32 million Americans live in an area without cancer care (33). Even for those living in proximity to a cancer care center, physical activity is the least commonly reported resource at cancer centers, and the availability of physical activity resources correlates highly with the availability of other support services (34). There is evidence that patients may be amenable to home-based programs but report wanting an exercise prescription that comes from their oncologist (31). The cost of HSCT and the required drug treatments, even with good insurance, can be a major financial burden (16), and there is not a good insurance-reimbursable model for exercise rehabilitation in HSCT patients. These barriers can be addressed with an exercise program that incorporates wearable technology.

Cancer Prevention

Current evidence does not support a preventative role for physical activity interventions in hematological cancers, in general (35). Uniquely, multiple myeloma is the only blood cancer associated with obesity and may be uniquely amenable to prevention strategies (36). This incurable cancer of antibody-producing plasma cells is preceded by a premalignant phase termed monoclonal gammopathy of undetermined significance (MGUS) that is easily detectable with a routine blood test. One percent of patients per year progress to malignant multiple myeloma, but pharmaceutical prevention strategies are controversial given their serious side effect profiles (16). Patients with a perceived vulnerability to cancer may be more responsive to health behavior modification (37). Targeting obesity, the only modifiable risk factor associated with multiple myeloma, with exercise and lifestyle interventions may have a meaningful clinical impact at both the individual and population levels (38). Wearable activity monitors are used extensively as tools to support physical activity interventions among many populations (39), but there are no data evaluating its utility in cancer prevention. Patients with MGUS may be a unique subpopulation within the hematological malignancies for whom wearable-based physical activity interventions may be highly effective. The role of exercise therapy to prevent disease progression from premalignancy to malignancy warrants more study.

HSCT Treatment

Not every patient with a hematological malignancy is a candidate for HSCT. Factors considered include age, body mass index, functional status and frailty, left ventricular ejection fraction, pulmonary function, psychosocial evaluation, kidney, and liver function (40). Failure to meet a center’s criteria for HSCT may prevent a patient from qualifying for therapy, and older adults are more likely to be declined for intensive treatment (41). In particular, performance status and frailty are assessed using subjective, semiquantitative scoring systems (Karnofsky, Eastern Cooperative Oncology Group Status, etc.). Assessed during a single clinic visit, performance status cannot capture an individual’s typical physical activity patterns, and oncologists question whether these scoring systems truly capture the information they are designed to assess (42). Wearable activity monitors can provide a more quantitative, unbiased picture of an individual’s ability to participate in activities of daily living (43). Exercise interventions may improve poor performance status and reduce frailty, thereby improving patients’ candidacy for and success during and after HSCT. Wearable activity monitors can provide high-resolution data to providers about typical/baseline levels of physical activity, compliance with exercise prescription, and improvements in daily physical activity over time.

During HSCT

The ACSM recently launched the Moving through Cancer initiative to ensure people living with and beyond cancer are assessed, advised, referred to, and engaged in appropriate exercise and rehabilitation programming as a standard of care (44). The routine integration of wearable activity monitors and exercise prescriptions into the clinical workflow could be a key component of this process but will require a culture change for many cancer centers (45). Lobelo et al. (46) proposed a framework for integrating wearable activity monitors and other mobile health technologies into the clinical workflow to promote physical activity among patients and inform clinical decisions.

During the typical course of blood cancer treatment, patients receive induction and consolidation therapy to treat the initial cancer and then wait several weeks in preparation for the transplant. Adult patients may wait up to 6 wk while the evaluation process is completed, a matched donor is identified and the donation is harvested, and bed space for the transplant is secured. This is an ideal time point for interventions designed to improve the health of patients before transplant. Wearable activity monitors could be used to support prehabilitation physical activity interventions during this time. Wiskemann et al. (13) found a physical activity intervention that began pretransplant to be effective for improving outcomes during and after HSCT.

Eighty percent of patients with cancer report that they would prefer a home-based exercise program provided by their oncologist (31) with a low-to-moderate intensity aerobic component, like walking (47). There is strong evidence that self-directed physical activity interventions are as effective as facility-centered,
supervised programs (48,49). In addition, considering the high cost of HSCT treatment (~$2.2 million) (16), home-based exercise programs may be a more cost-efficient option compared with supervised programs. This is an important consideration for the large number of patients who experience crippling financial strain as a result of HSCT treatment (50). Taken together, wearable technology may be an excellent solution for the millions of Americans who do not live close to a cancer center or who are experiencing financial toxicity as a result of their disease and would not be able to participate in a facility-based program with their oncologist (51).

During hospital admission for HSCT, most adult and pediatric patients receive exercise therapy from physical or occupational therapists (32). These individuals are critical members of the care team, but their time with patients is limited by the high demand for their services. Partially self-administered programs are effective during transplant, but there is a need for daily modifications to an individual’s exercise prescription as the severity of symptoms can evolve rapidly throughout the transplant process (53). Wearable health technologies that are integrated with the electronic medical record could provide high-resolution feedback to providers, allowing them to more efficiently prioritize patient needs, evaluate the need for changes to exercise prescriptions, and create discharge plans. Nurses and oncologists may find physical activity data valuable, as a digital biomarker to detect changes in a patient’s clinical progress (54).

Wearable-based interventions may be particularly useful in addressing unique barriers in elderly and pediatric populations. Elderly patients who need modifications to lower exercise intensity can be identified through wearable technologies. Wearable activity monitors accurately capture low- to moderate-intensity activity (4). Children and adolescents may benefit from activity interventions that have a strong component of active play. Wearable-based interventions can be delivered via the internet (55) and provided in game-based formats that may be more engaging for young patients (2). Broadly, game-based therapies may be beneficial for all HSCT patients who experience psychological sequelae from prolonged social isolation during HSCT (6).

Survivorship

As survival after HSCT treatment improves, particularly in adolescents and young adults, the challenge becomes devising therapies that address long-term sequelae of blood cancer (56). Pediatric patients report more severe posttransplant symptoms than adults in all domains, except for anxiety and depression (57), which may limit their ability to advance toward independence (58).

Adolescent HSCT recipients experience cardiac complications and an increased risk of early-onset heart failure from exposure to anthracycline, cyclophosphamide, infection, radiation, and dimethylsulfoxide in cryopreserved stem cell product (59). Exercise is effective in other cancer populations with treatment-induced cardiac toxicity (40). Emerging evidence suggests that structured exercise may also protect against treatment-induced cardiotoxicity (60), although few studies have explored this empirically (61). However, although physical activity reduces cardiovascular complications in multiple diseases, its role as a therapeutic approach to mitigate cardiovascular consequences related to cancer therapy is in its infancy (60).

### TABLE 1. Proposed benefits and limitations of incorporating wearable technology in exercise prescriptions for HSCT patients.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Wearing wearable devices may increase physical activity short-term</td>
<td>• Baseline adherence to wearable technology is not yet quantified</td>
</tr>
<tr>
<td>• Amenable to incorporation at all stages of treatment</td>
<td>• Wearable technology use may decrease in efficacy over time</td>
</tr>
<tr>
<td>• Self-directed exercise interventions are as effective as supervised interventions</td>
<td>• Lack of clear insurance reimbursement plan for wearable technology</td>
</tr>
<tr>
<td>• HSCT patients report wanting at-home exercise programs</td>
<td>• Wearable technology data are not fully integrated into the electronic medical record</td>
</tr>
<tr>
<td>• Wearable devices can be worn anywhere</td>
<td>• Lack of guidelines and consensus for wearable activity monitors</td>
</tr>
<tr>
<td>• Accurate at measuring low to moderate physical activity</td>
<td>• HSCT patients may want direct supervision of their exercise program from their oncologist</td>
</tr>
</tbody>
</table>

### TABLE 2. Challenges and research opportunities in incorporating wearable technology into the routine care of HSCT patients.

<table>
<thead>
<tr>
<th>Target Group</th>
<th>Challenge</th>
<th>Potential Solution</th>
</tr>
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<tbody>
<tr>
<td>Providers</td>
<td>What are the barriers to providing exercise prescription?</td>
<td>• Quantify providers’ barrier motivations and barriers to wearable technology and prescribing exercise to HSCT patients.</td>
</tr>
<tr>
<td></td>
<td>Who should monitor wearable technology data and individualize exercise interventions?</td>
<td>• Develop training and workflows to overcome barriers and reinforce motivations.</td>
</tr>
<tr>
<td>Patients</td>
<td>What is the best exercise intervention?</td>
<td>• Integrate exercise physiologists as part of the treatment team.</td>
</tr>
<tr>
<td></td>
<td>How long are patients willing to adhere to wearing a device?</td>
<td>• Evaluate broad wearable technology data sets of exercise interventions to determine maximal benefits.</td>
</tr>
<tr>
<td></td>
<td>How long does it take for desensitization of wearable intervention to take place?</td>
<td>• Quantify intensity tolerance in elderly HSCT patients.</td>
</tr>
<tr>
<td>Integration</td>
<td>What is a sustainable financial model for wearable technology-based interventions?</td>
<td>• Use wearable technology data to develop gamified interventions across the life span.</td>
</tr>
<tr>
<td>into care</td>
<td>How do hospitals integrate physical activity into the medical record?</td>
<td>• Determine adherence at each stage of HSCT treatment.</td>
</tr>
<tr>
<td></td>
<td>How much physical activity should providers prescribe across the life span?</td>
<td>• Create unique efforts to determine compliance and efficacy in pediatric and young adult populations.</td>
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Over half of adult HSCT patients experience fatigue 6 months after transplantation (32) and impairments in the ability to return to work that can persist up to 6 yr after transplant (62). As in the pretransplant period, home-based therapies are effective for reducing fatigue and distress and improving cardiorespiratory fitness in HSCT survivors (13). Wearable activity monitors can support home-based exercise interventions among survivors as well.

POTENTIAL BENEFITS AND PITFALLS OF WEARABLE TECHNOLOGY IN HSCT

Potential benefits and pitfalls of wearable activity monitors are shown in Table 1. Currently, there are no data on adherence to wearable-based interventions in HSCT patients. In other populations, the efficacy of wearable-based interventions decreases over time (2,39). This is why activity monitors in isolation are not sufficient for promoting long-term physical activity. They must be accompanied by evidence-based behavior change techniques that must still be tested in HSCT patients. Patients with cancer report wanting an exercise program from their oncologist (31), believing that their oncologist has extensive knowledge about their treatment, current medications, disease/treatment-related symptoms, and knowledge about effective exercise prescriptions that are most appropriate for the patient’s needs. Conversely, physicians report not having the expertise necessary to prescribe exercise (31). Wearable technology platforms will need to be easy to use and provide straightforward, actionable information to be embraced by oncologists. In 2019, new billing codes were created for wearable device monitoring (CPT codes 99453, 99454, and 99457), creating a potential reimbursement structure for the use of wearable fitness trackers in clinical settings. Still, it is unclear whether insurers are reimbursing for these claims. There are no business models for the widescale implementation of wearables in cancer medicine, beyond self-pay and research models.

FUTURE STUDIES

Table 2 shows potential questions to be addressed before wearable technology can become an active part of HSCT treatment. More than half of surveyed Canadian oncologists believe exercise is important, beneficial, and safe, but only 29.5% agree that patients with cancer are capable of exercise during treatment. Less than half of these oncologists agree that exercise recommendations would be well received by patients, and less than 30% believe that patients would follow their recommendations (63). These clinician attitudes have not been reevaluated since the release of cancer-specific exercise guidelines, and there are no data of oncologists’ attitudes toward wearable technology in HSCT. Future studies should identify barriers to implementation at both the patient and clinician level and develop educational tools and modifications to clinical workflow that address these barriers.

Most research exercise interventions that have been performed in HSCT patients were performed under the supervision of an investigator who ensured that the target workload was achieved, or it is assumed that the target is achieved. These interventions are difficult to compare to each other. Wearable technology offers the opportunity to collect data that could be used to compare risk or outcomes across a continuum of intensity, including patients who either underperform or overperform based on their exercise prescription. The dose-response relation between exercise intensity and outcome has not been quantified in HSCT.

CONCLUSION

As a collaborative consortium of hematologist oncologists, physiologists, and health promotion experts, we propose that wearable technology can be used to facilitate exercise therapy in adult and pediatric HSCT patients before, during, and after transplant. Exercise improves QOL at all stages of treatment, decreases fatigue, improves physical performance, blunts muscle atrophy, and improves mood and feelings of self-control. Wearable technology has a long history of use in exercise intervention studies and could play a crucial role in increasing physical activity among HSCT patients throughout treatment. Wearable technology may be uniquely suited for pediatric patients who have physical activity requirements and survivorship needs that are different than the general adult HSCT population. Future studies should evaluate the role of wearable technology in facilitating exercise prescription in HSCT and its role in addressing barriers to therapy as we outline here.

Acknowledgment

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