

Work in cancer survivors: a model for practice and research

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Received: 27 May 2010 / Accepted: 30 September 2010
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Abstract

Introduction As with other illnesses, several variables can impact the transition back to the workplace, long-term work productivity, or job retention among cancer survivors. We developed a model related to work and cancer based in part on the general area of work disability and the specific literature on cancer survivors and work.

The opinions and assertions contained herein are the private views of the authors and are not to be construed as being official or as reflecting the views of the Uniformed Services University of the Health Sciences or the Department of Defense.

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Methods A systematic search of the literature on work and cancer was conducted to determine whether an evidence base existed to support the proposed model.

Results Forty-five papers met the review criteria. The percentage of studies that addressed modifiable categories included in the proposed model was: health and well-being (20%), symptoms (16%), function (24%), work demands (9%), work environment (18%), and policy, procedures, and economic factors (16%). Return to work was the most common work outcome studied although problems with productivity and retention are reported in the general cancer and work literature. Wide variation in definition of cancer survivor was reported and breast cancer survivors were studied most often. Each of the categories in the model has some empirical support.

Discussion The model considers the health, functional status in relation to demands, work environment, and policy, procedures, and financial factors. The model allows the clinician and survivor to consider factors that can be addressed by the health care provider, survivor, and workplace. *Implications for Cancer Survivors.* This model provides a framework to aid in conceptualizing problems related to work.

Keywords Cancer · Work · Systematic review

Introduction

Survival for most cancers has continued to rise over the past few decades [1]. Detection and treatment have also evolved so that cancer is diagnosed earlier and often times treated with less impact on function than in the past. Long-term and late medical and behavioral effects of cancer and its treatment [2] are beginning to be more clearly identified. The relation

of these residual and late effects to work outcomes is also becoming more evident.

Return to work after cancer

For some individuals with a history of cancer and a desire to be occupationally active, returning to or remaining at work can be a challenge [3]. Work is often related to having a purpose in life [4], a sense of contributing [5], a distraction, and even one's self-esteem [6]. Repetitive exposure to required work tasks may even help to facilitate recovery in physical, cognitive, emotional, and interpersonal domains of functioning that may have declined during primary treatment [7]. Work can also provide necessary income and, in many cases, particularly in the United States, health insurance. Research related to work disability prevention over the past two decades indicates that work outcomes in those at work with various chronic health problems are influenced by a pattern of factors within the individual, environment, and society that may also be operational among survivors of cancer [8].

A recent meta-analysis of cancer and employment in both the United States and Europe [9] noted an increased risk of unemployment in cancer survivors (relative risk = 1.37, 95% CI: 1.21–1.55). Only 67.2% of cancer survivors were working in contrast to over 80% in the non-cancer controls. Although the majority of cancer survivors are able to work, lower levels of productivity [10, 11], lower work ability [12], and reduced job retention [13] have been reported. However, these studies were cross-sectional and the causal nature of these relationships remains unclear. It is important to note that these studies were conducted on breast cancer survivors 3–4 years post treatment and these associations remain to be determined among other types of cancer. A study of a heterogeneous group of cancer survivors ($n=1433$) found that 13% of those working 4 years post cancer diagnosis decided to leave work because of “cancer related reasons” [14]. This study provides some data indicating an association between problems in cancer survivorship and work. It is unclear whether those who left the workplace would have remained at work if the problems related to cancer were effectively addressed.

Work-related interventions

Research on work-related interventions for cancer survivors is limited. In a review of 100 potential papers on return to work interventions for female breast cancer survivors [15], only four studies met rigorous inclusion criteria and of these four only a single study used a control group. The interventions highlighted in the review included approaches that were physical (e.g., exercise training), psychological (e.g., counseling), and social (e.g., encouragement to return

to work and social activities). Return to work rates were reported as high (75–85%). However, with the absence of a control group it is impossible to conclude that the intervention studied was responsible for the outcome. The single study that used a control group [16] investigated a counseling intervention which encouraged patients to exercise, discuss feelings, return to work, and become socially active. This intervention resulted in significantly improved return to work rates among breast cancer survivors 12–18 months post surgery (76%) when compared to a usual care control group (54%).

Factors related to work after cancer

Spelten et al. [17] and Steiner et al. [18] have provided a summary of specific factors related to cancer and work outcomes. Most of the research to date indicates that return to work can be related to health variables such as disease stage, cancer site, time since treatment, physical symptoms, and fatigue; work-related variables such as positive attitude of co-workers, control over work hours, manual labor, and physical demands at work; and other variables such as social support and attitude towards the value of work. Work outcomes highlighted in this literature include return to work, work intensity, change in work role and content, reduced work schedules, and economic status. In employees with other chronic illnesses, psychological and health-related distress is also associated with poorer outcomes such as higher work limitations, higher presenteeism, and lower workplace support. Individuals with different chronic illnesses (i.e., musculoskeletal pain, arthritis and rheumatism, asthma, depression and anxiety, heart disease, diabetes) differ in health related distress, illness management, disclosure of illness, work limitations, and episodes of less than 5 days of presenteeism [19].

The need for a model

An evidence-based model that can help guide evaluation of workers with cancer, prevention of long-term work disability, and interventions to reduce days lost and enhance productivity for cancer survivors does not exist. Despite this, recommendations for cancer survivors based on other work disabilities (e.g., low back or upper extremity pain) are being promulgated. For example, the Job Accommodation Network, an online resource of the U.S. Department of Labor suggests that an individual with breast cancer who can no longer type for long periods should be accommodated with speech recognition software or a cancer survivor (type not indicated) with cancer related fatigue needs to make certain that work materials and equipment be within reach range [20]. While providing accommodations is a

positive first step in aiding cancer survivors at work, the proposed accommodations are neither evidence-based nor appropriate for many cancer survivors. However, at present, most solutions to problems of work and cancer are based upon a generic understanding of chronic illness and work, or information on musculoskeletal illness and other illnesses such as arthritis and cardiovascular disease. While we can build off of the work disability prevention knowledge base, there is a need to titrate evaluation, intervention, and workplace accommodation efforts to certain unique characteristics of cancer survivors.

A comprehensive conceptualization of cancer survivorship and work can potentially guide the evaluation, prevention, and management of survivors who experience problems returning to and/or remaining at work. Such efforts could also assist those with cancer-related problems maintain or enhance their abilities at work. Over the past decade, there have been well thought out models regarding cancer and work [13, 14, 18]. Some of these models were developed from the perspective of health economics [13, 14]. While others [18] were derived from a generic model of health-related quality of life [21]. The primary intent of these models was to better understand factors involved in cancer and work in general, and not to directly provide guidance for the evaluation, prevention, and management of problems experienced by those in need of some type of assistance. The model described in this paper was specifically developed with both a framework for future research and attention to clinical and workplace application.

A detailed review of many of the models that were developed to provide an understanding of work and musculoskeletal illness [22] reported that these models have varying underlying constructs and research traditions. The various models were categorized as biomedical, psychosocial, psychiatric, forensic, ecological/case management, economic, and biopsychosocial. After reviewing each of these major theoretical approaches, criteria for the development of future models related to illness and work were presented. These include identification of modifiable and non-modifiable personal characteristics and their reciprocal relationships at the macro- (e.g., cultural, legal, economic), meso- (e.g., workplace, health care, peers), and micro-levels (e.g., medical, psychosocial, cognitive-motivational factors, workplace physical demands, time from illness onset). The model in this paper identifies a set of factors that represent personal, macro-, meso-, and micro-levels. Clinicians and others involved in evaluating, preventing, and managing work-related problems among cancer survivors can use this framework to help address these problems and to optimize overall adjustment.

Methods

We developed a model using existing knowledge of the cancer survivorship and work disability literatures and clinical experience, which has potential implications for both research and practice. In developing the model prior to a formal literature search, we included information obtained through qualitative studies and case examples which are typically not considered in systematic reviews. Following our conceptualization, we completed a systematic review of the literature related to cancer and work. We also reviewed existing models in cancer and work as well as models of general work disability and occupational musculoskeletal work disability. This information provided the evidence base for the model. It also helped the authors to identify areas in need of further research and development. As with any model of this type, it should be emphasized that this is an evolving conceptualization of factors related to cancer and work at this point in time.

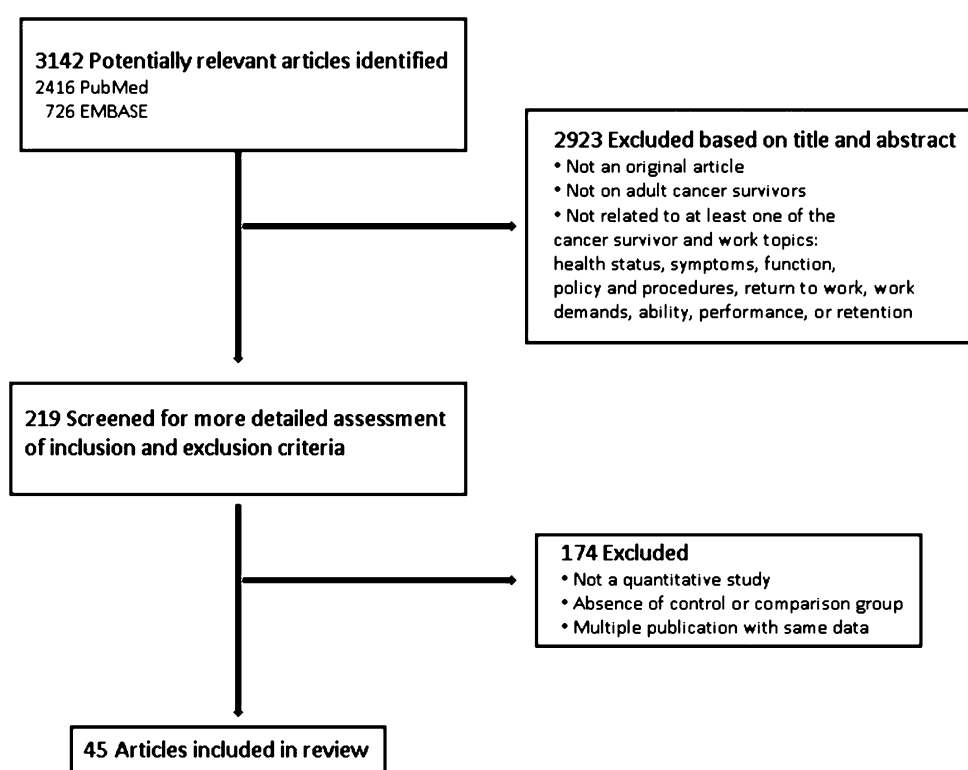
Systematic review search strategy

A literature search was conducted using the electronic databases PubMed and EMBASE (Fig. 1). Limits on the search included studies published from January 2000 to March 2010, English language, humans, and adults (18+ years). Three sets of terms were used in the literature search: 1) *cancer, cancer patient, cancer survivor, or neoplasm*; 2) *employment, work, workplace, work environment, unemployment, return-to-work, work ability, work performance, work retention, or work demands*; and 3) *model, health, function, symptoms, policy, terms, conditions, or procedure*. An initial search was conducted on each of the three sets of terms, which were combined with “or.” Subsequently, the results of these three searches were collectively combined with “and.” Limits on the search terms included title and abstract. For the first exclusion criteria, papers were removed if they were not original articles and did not investigate adult cancer patients post diagnosis or post primary treatment. The second exclusion criteria included qualitative methodology or absence of a control or comparison group. Although unpaid work such as managing a household is clearly valued work both economically and personally, the review was limited to full time paid employment.

Results

Case definition

There are many definitions of cancer survivor in the literature [23–25]. These definitions range from immedi-

Fig. 1 Flow chart of study selection process

ately following diagnosis, during active treatment, post primary treatment, as well as families and caregivers of individuals with a cancer history. Table 1 highlights the various case definitions used in the papers that met the criteria for inclusion in the systematic review. The results of the search indicated that 60% ($n=27$) of the studies defined survivors as post diagnosis, 20% ($n=9$) defined survivors as post primary treatment, and 20% (9) did not specify the time post diagnosis. We included studies that used a broad definition of cancer survivorship beginning at either diagnosis or termination of primary treatment in order to make certain that we included the majority of research in the area.

There was great variability across studies in both time from diagnosis and time from completion of primary treatment to study onset. Mean time from diagnosis varied from 0.06 to 15 years ($n=12$ studies) and mean time from primary treatment ranged from 4.2 to 14 years ($n=4$ studies). Time from diagnosis ranged from 0.04 to 32 years and time from primary treatment varied from 0.25 to 25 years among those studies that provided an exact range in years post diagnosis ($n=17$) or post treatment ($n=6$). In nine percent ($n=4$) of the studies, time since diagnosis was not specified in the paper. Types of cancers and stages also varied considerably among studies. However, consistent with the epidemiology of cancer, the most common cancer studied was breast cancer followed by prostate cancer.

There were only a few studies on colon, cervical, ovarian, uterine, leukemia, lymphoma, stomach, brain, oral, or testicular cancers.

Work outcomes

The work outcomes found in the literature review are presented in Table 2. Work outcomes were represented as follows: return to work (27%), work ability (27%), work performance (22%), and work retention (13%).

A clinical model of cancer and work

Model overview

Figure 2 illustrates the clinical model with seven broad categories of variables associated with the four work outcomes indicated above. The elements of the model supported in the literature review are presented in Table 3. The percentage of studies found in the review that were related to modifiable categories in the model include: health and well-being (20%), symptoms (16%), function (24%), work demands (9%), work environment (18%), and policies, procedures, and economic factors (16%). While relationships (directional and bidirectional) among categories are specified, they are not exhaustive. Others certainly are possible. In

Table 1 Case definitions of cancer survivor in work and cancer literature

Author, Year	Post dx	Post tx	RANGE (in years)	MEAN (in years)	Breast	Prostate	Colon	Cervical	Brain	Ovarian	Uterine	Retino-blastoma	Leukemia	Melanoma	Lymphoma	Stomach	Endo-metrial	Nasopharyngeal	Oral	Testicular	
Almurshed, 2009 [50]	X			^a		X															
Avis, Crawford, & Manuel, 2005 [51]	X		0.3–3.5	1.9	X																
Awadalla, Obaeri, Gholoum, Khalid, Hamad, & Jacob, 2007 [52]	X		≥1	NS	X		X														
Bradley, Bednarek, & Neumark, 2002 [13]	X		1–32	7	X																
Bradley, Neumark, Luo, Bednarek, & Schenk, 2005 [53]	X		0.25–0.3	NS	X																
Bradley, Rose, Lugendorf, Costanzo, & Anderson, 2006 [54]	X		6–20	11.2		X											X				
Carlson, Dalton, Diderichsen, & Johansen, 2008 [55]	X		≥1	NS																	
Chan, Ngan, Yip, Lu, Lau, & Tang, 2001 [56]	X		0.04–0.12	0.06			X		X												
Chirikos, Russell-Jacobs, & Cantor, 2002 [57]	X		≥5	NS	X																
Drolet, Maunsell, Brisson, Masse, & Deschenes, 2005 [58]	X		<0.08	NS	X																
Fang, Chiu, Kuo, Wang, Leung, Chen, et al., 2002 [59]		X	>2	NS														X			
Fang, Tsai, Chien, Chiu, & Wang, 2004 [60]		X	>2	NS																	X
Feuerstein, Hansen, Calvio, Johnson, & Ronquillo, 2007 [61]	X		^b								X										
Feuerstein, Luff, Harrington, & Olsen, 2007 [44]			NA	NA																	
Finkelstein, Tangka, Trogon, Sabatino, & Richardson, 2009 [62]	X		<1	NS																	
Fleer, Hoekstra, Sleijfer, Tuinman, & Klip, 2006 [63]		X	0.25–24	10																	X
Gudbergsson, Fossa, Borgeraas, & Dahl, 2006 [64]	X		2–6	4	X																X
Gudbergsson, Fossa, Samne, & Dahl, 2007 [47]	X		1–5	NS	X																X

Table 1 (continued)

Author, Year	Post dx	Post tx	RANGE (in years)	MEAN (in years)	Breast	Prostate	Colon	Cervical	Brain	Ovarian	Uterine	Retino-blastoma	Leukemia	Melanoma	Lymphoma	Stomach	Endo-metrial	Nasopharyngeal	Oral	Testicular	
Gudbergsson, Fossa, & Dahl, 2008 [65]	X		2-6	NS	X	X															X
Gudbergsson, Fossa, & Dahl, 2008 [66]	X		2-6	NS	X	X															X
Hakanen & Lindbohm, 2008 [67]	X		2-6	NS	X																
Hansen, Feuerstein, Calvio, & Olsen, 2008 [10]	X		4	3.8	X																
Harder, Cornelissen, Van Gool, Duivenvoorden, Eijkenboom, & Van Den Bent, 2002 [68]		X	1.8-6.8	3.6 ^c																	
Hegleson & Tomich, 2005 [69]	X		4.5-6.8	5.5	X																
Hewitt, Rowland, & Yancik, 2003 [70]	X		<2 to 20+	NS																	
Joly, Heron, Kaluzinski, Bottet, Brune, Allouache, et al., 2002 [71]		X	5-20	11																	X
Korfage, Essink-Bot, Mols, van de Poij-Franse, Kruitwagen, & van Ballegooijen, 2009 [72]	X		2-11	6.6			X														
Lavigne, Griggs, Tu, & Lerner, 2008 [11]		X	>1	NS	X																
Lee, Lee, Bae, Kim, Kim, Ryu, et al., 2008 [73]	X																				X
McKenma, Fabian, Hurley, McMahon, & West, 2007 [74]			NA																		
Mols, Aaronson, Vingerhoets, Coebergh, Vreugdenhil, Lybeert, et al., 2007 [75]	X		5-15	NS									X								
Noorda, van Kreijl, Vrouwenraets, Nieweg, Muller, Kroon, et al., 2007 [76]		X	3-25	14																	X
Norredam, Meara, Landrum, Huskamp, & Keating, 2009 [77]	X		≥4	15																	
Park & Kim, 2009 [78]	X		5-15	NS	X																
Peuckmann, Ekholm, Sjogren, Rasmussen, Christiansen, Moller, et al., 2009 [79]		X	1.3-11.9	4.2																	
Shin, Noh, Lee, Nam, Park, Ahn, et al., 2009 [80]		X	1.3-11.9	4.2																	

Short, Vasey, & BeLue, 2008 [81]	X	3.1–5	3.8	X	X	X
Short, Vasey, & Moran, 2008 [82]	X	2.2–5.8	3.8			
Syse, Tretli, & Kravdal, 2008 [83]	X	<1 to >10	NS			
Taskila, Marikainen, Hietanen, & Lindbom, 2007 [12]	X			X	X	X
Taskila-Abbrandt, Martikainen, Virtansen, Pukkala, Hietanen, & Lindbohm, 2004 [84]	X					
Taskila-Abbrandt, Pukkala, Martikainen, & Karjalainen, 2005 [85]	X					
Hietanen, 2005 [85]	X					
Tunceli, Short, Moran, & Tunceli, 2009 [86]	X	2.2–5.8	3.8			
Wettergren, Bjorkholm, Axdorff, Bowling, & Languis-Eklof, 2003 [87]	X	6–26	14 ^c			X
Yabroff, Lawrence, Clauser, Davis, & Brown, 2004 [88]	X	<1 to >11	NS			
TOTAL # OF ARTICLES	34	9				
% OF ARTICLES	76	20				

^a Newly diagnosed

^b History of work for at least 1 year prior to diagnosis

^c Median

Table 2 Work outcomes

Author (Year)	Variables	Findings
Return to Work (RTW)		
Almurshed (2009) [50]	Unemployment	Of the patients hospitalized with colorectal cancer 54% were unemployed compared to 24% of the controls (over 30 years old and of Saudi Arabian nationality; OR=3.7, $p<0.05$). Saudi Arabia
Korfage, Essink-Bot, Mols, van de Poll-Franse, Kruitwagen, & van Ballegooijen (2009) [72]	Employment	Cervical cancer survivors had lower rates of paid employment than the comparison group (41% vs. 58% having paid jobs). Netherlands
Park & Kim (2009) [78]	RTW	Cancer patients were more likely to lose their job than cancer-free individuals. Patients with pancreatic, lung, brain, and CNS cancer, or non-Hodgkin's lymphoma were more likely to lose their jobs sooner than other cancer patients. The amount of time before re-employment was significantly longer in cancer patients than the control group. Patients with liver, brain, and CNS cancer, and leukemia were less likely to be re-employed than other cancer patients. South Korea
Lee, Lee, Bae, Kim, Kim, Ruy, et al. (2008) [73]	RTW	The proportion of non-working stomach cancer survivors (46.6%) was significantly higher than the general population (36.5%). There was a stronger association between non-working status, older age, and female gender among stomach cancer survivors compared to the general population. Korea
Syse, Tretli, & Kravdal (2008) [83] ^a	Employment	Leukemia, Non-Hodgkin disease, brain, bone, lung, colorectal, and head-and-neck cancer were associated with lowered employment for both genders (ranging from 25% to 80%), compared to the general population. Norway
Bradley, Neumark, Luo, Bednaret, & Schenk (2005) [53]	RTW	Prostate cancer survivors were 10% less likely to be working 6 months after diagnosis. At 12 months after diagnosis, however, there were no significant differences in employment. USA
Drolet, Maunsell, Brisson, Brisson, Masse, & Meschenes (2005) [58]	RTW	More breast cancer survivors (21%) were not working 3 years post diagnosis compared with women without cancer (15%). Older age (50–59) among breast cancer survivors increased the likelihood of not working 3 years post diagnosis. Canada
Taskila-Abrant, Pukkala, Martikainen, Karjalainen, & Hietanen (2005) [85]	Employment Rate	Cancer survivors diagnosed with cancer of the tongue, larynx, lung, or nervous system, or with multiple myeloma, showed a 15% reduction in employment. Employment rate did not significantly differ between breast, testicular, or prostate cancer survivors compared to non-cancer controls. Lung cancer survivors were least likely to be employed. The employment rate for those diagnosed with melanoma of the skin was slightly higher than non-cancer controls. Finland
Yabroff, Lawrence, Clauser, Davis, & Brown (2004) [88]	RTW	Cancer survivors were less likely than controls to have a job at the time of the study and more likely to be unable to work due to health. USA
Hewitt, Rowland, Yancok (2003) (77)	RTW	17% of those with a self-reported cancer history were unable to work due to health-related work limits compared to 5% of the control group. USA

Table 2 (continued)

Author (Year)	Variables	Findings
Bradley, Bednarek, & Neumark (2002) [13]	RTW	Breast cancer survivors were 11% less likely to work if their spouse had employer-based health insurance. USA
Harder, Cornelissen, Van Gool, Duivenvoorden, Eijkenboom, & Van Den Bent (2002) [68]	RTW	47% of adult survivors receiving bone marrow transplantation were able to establish full-time or part-time work or school attendance. Netherlands
Work ability		
Norredam, Meara, Landrum, Huskamp, & Keating (2009) [77]	Perceived Confidence in Finding a New Job	Female cancer survivors exhibited lower confidence in finding an equally good job in the next few months compared to those without cancer. No significant difference was observed among male cancer survivors and non-cancer patients. Denmark
Gudbergsson, Fossa, & Dahl (2008) [65]	Mental and Physical Work Ability	Among females who had breast cancer and males who had testicular or prostate cancer, those survivors who changed jobs had a lower mental and physical work ability compared to those who did not change jobs. Mental work ability was negatively associated with work ability. Norway
Gudbergsson, Fossa, & Dahl (2008) [66]	Physical and Mental Work Ability	Tumor-free cancer survivors with breast, prostate, and testicular cancer diagnosed 2–6 years ago reported poorer physical and mental work ability compared to the general population. Cancer survivors had significantly lower vigor than the controls. There was no significant difference for dedication and absorption. Norway
Hakanen & Lindbohm (2008) [67]	Work Engagement	Although level of work engagement was high in both breast cancer survivors and in non-cancer controls, it was higher among controls. Finland
Hansen, Feuerstein, Calvio, & Olsen (2008) [10]	Work Output	Higher levels of age-adjusted work limitations were reported by breast cancer survivors four years post-diagnosis as compared to a non-cancer comparison group. USA
Lavigne, Griggs, Tu, & Lerner (2008) [11]	Work Productivity and Performance	Breast cancer survivors were 3% lower than the healthy control group in work productivity. Compared to stage 0, stage 1 and 2 breast cancer survivors were correlated with reductions in work performance (1.63%, 3.05%). USA
Lee, Lee, Bae, Kim, Kim, Ryu, et al. (2008) [73]	Work Ability	Stomach cancer survivors exhibited reduced work ability, reduced work hours, and experienced more difficulties in gainful work. Korea
Awadalla, Ohaeri, Gholoum, Khalid, Hamad, & Jacob (2007) [52]	Perceived Work Capacity	Patients with breast and cervical cancer rated their work capacity at an average of 80%, while family rated the survivor's work capacity at 93%. Kuwait
Feuerstein, Hansen, Calvio, Johnson, & Ronquillo (2007) [61]	Work Limitations	Work limitations were greater for the brain tumor group than for the non-cancer comparison group. USA
Taskila, Martikainen, Hietanen, & Lindbohm (2007) [12]	Work ability	Work ability of cancer survivors was no different than demographically-matched healthy controls. Among cancer survivors, their physical work ability had deteriorated 26% and mental work ability decreased 19% due to cancer. Finland
Bradley, Neumark, Luo, Bednarek, & Schenk (2005) [53]	Functioning at Work	Some prostate cancer patients reported that 12 months after diagnosis, cancer and its treatment interfered with cognitive (5–16%) and physical functioning (22–30%) at work. USA
Chan, Ngan, Yip, Li, Lau, & Tang (2001) [56]	Work Capacity	Patients who had chemotherapy showed improved work capacity after completion of treatment whereas the group of patients who had surgery experienced a decreased work capacity. China

Table 2 (continued)

Author (Year)	Variables	Findings
Work performance		
Norredam, Meara, Landrum, Huskamp, & Keating (2009) [77]	Working Hours Missed Work	No difference between cancer survivors and controls in hours worked per week or missed work due to illness at >4 years post diagnosis. Denmark
Gudbergsson, Fossa, & Dahl (2008) [65]	Working Hours	Among females who had breast cancer and males who had testicular or prostate cancer, those who changed jobs had a larger proportion of part-time work compared to those who did not change jobs.
	Sick Leave	The group with work changes took more weeks of sick leave due to cancer diagnosis and treatment compared to the non-change group. Norway
Lavigne, Griggs, Tu, & Lerner (2008) [11]	Working Hours	For the breast cancer survivors working full-time, there was an average of 2.48 h of loss of work over a 2-week period. For the one-third of survivors who returned to work even though they “did not feel well,” (3 years post treatment), some reported that it took 1.4 extra hours out of a 2-week work period to complete normal tasks. USA
	Full-Time Employment	12% of male cancer survivors (age 55–65) were employed full-time and worked 4.9 h less than non-cancer controls.
Short, Vasey, & Moran (2008) [82]	Working Hours	Cancer survivors of both genders with newly diagnosed cancers worked significantly less than non-cancer controls. Cancer survivorship significantly affected the female employment rate (full-time status, hours per week) according to multivariate estimates, but little evidence was found among male cancer survivors. USA
	Missed Work	Brain tumor survivors missed more total days from work than the non-cancer comparison group. USA
Gudbergsson, Fossa, Borgeraas, & Dahl (2006) [64]	Working Hours	No difference between cancer survivors (breast, prostate, and testicular cancers) and controls in work hours. Norway
Avis, Crawford, & Manuel (2005) [51]	Sick Leave	Breast cancer patients missed an average of 29 work days compared to non-patient sample. USA
Yabroff, Lawrence, Clauser, Davis, & Brown (2004) [88] ^b	Missed Work	Cancer survivors had lower productivity (days missed from work) and utility rates than controls.
	Work Limitations	The cancer survivors were more limited than controls in the amount or kind of work. USA
Bradley, Bednarek, & Neumark (2002) [13]	Working Hours	Among those who were employed, breast cancer survivors worked on average 3.4 h more per week than non-cancer controls. During the years immediately following diagnosis, no difference existed between groups in the number of hours worked per week, but after 3 years, breast cancer survivors work on average 4 h more per week. USA
	Work Effort	Breast cancer survivors who were working at the time of their diagnosis had significantly larger reduction in annual market earnings compared to controls over a 5-year period. This was more clearly related to reduced work effort as opposed to changes in pay rate. USA
Work retention		
Park & Kim (2009) [78]	Job Loss	The mean time until job loss was shorter in cancer patients than in the reference group. South Korea

Table 2 (continued)

Author (Year)	Variables	Findings
Tunceli, Short, Moran, & Runceli (2009) [86]	Work Exit	Cancer survivors without employer-sponsored health insurance left work more frequently than those with no history of cancer.
	Work Tenure	The exit rate for those survivors with employer-sponsored health insurance was not statistically different from those with no history of cancer. Cancer survivors were more likely to work longer in managerial, professional, and technical jobs. USA
Peuckmann, Ekholm, Sjogren, Rasmussen, Christiansen, Moller, et al. (2009) [79]	Job termination Job change	Job termination or change in jobs was most likely in breast cancer survivors 50–59 years of age (13%). Denmark
Mols, Aaronson, Vingerhoets, Coebergh, Vreugdenhil, Lybeert, et al. (2007) [75] ^a	Work changes	41% of the non-Hodgkin lymphoma survivors stated that they had changed jobs, reduced number of hours worked, or completely stopped working due to cancer. Netherlands
Work exit		
Bradley, Rose, Lutgendorf, Costanzo, & Anderson (2006) [54]	Retirement	More endometrial cancer survivors (44.4%) were retired compared to cervical cancer survivors (18.2%) or healthy controls (29.5%). USA
Taskila-Abrant, Pukkala, Martikainen, Karjalainen, & Hietanen (2005) [85]	Retirement	Risk of retirement was two times higher for those with cancer of the nervous system or leukemia compared to non-cancer controls. Those with skin cancer showed no increase in risk of retirement. Finland

Studies were included in multiple categories.

^a Includes information that also relates to Work performance category

^b Includes information that also relates to Work ability category

Fig. 2 Cancer & work model

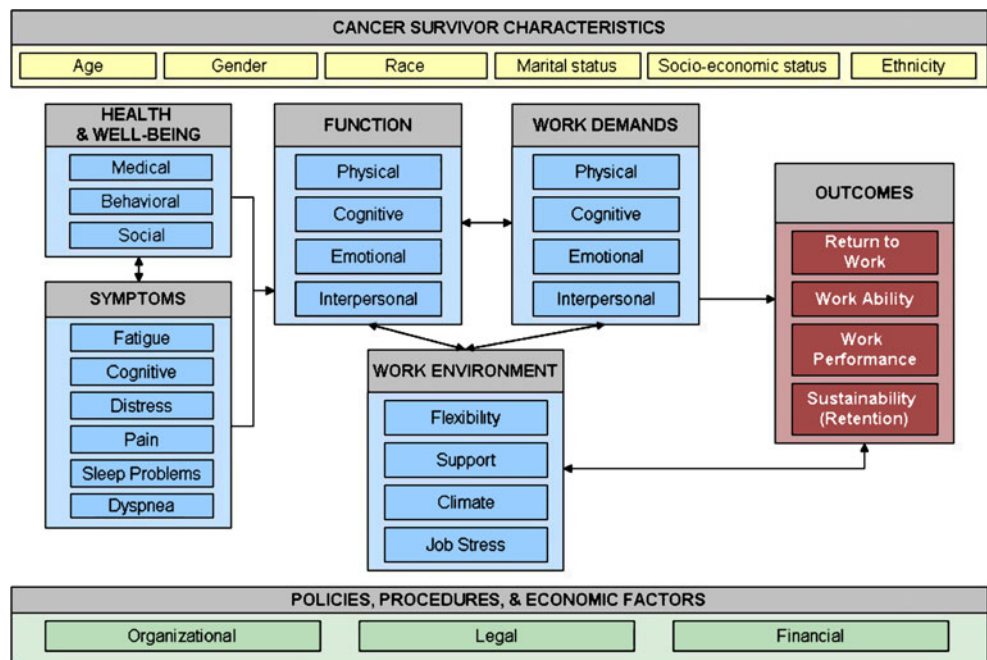


Table 3 Elements in model supported by literature search

Author (Year)	Variables	Findings
Health & well-being		
Finkelstein, Tangka, Trogdon, Sabatino, & Richardson (2009) [62]	Medical	Those receiving active cancer care (cancer group unspecified) treatment were less likely to be employed full time. Compared to those without cancer, those who were employed while being actively treated for cancer missed 22.3 more work days. USA
Peuckmann, Ekholm, Sjogren, Rasmussen, Christiansen, Moller, et al. (2009) [79]	Medical	Radiotherapy and endocrine therapy in post menopausal, long-term breast cancer survivors (5–15 years post primary surgery) were significantly associated with ending employment and changing jobs. Denmark
Gudbergsson, Fossa, & Dahl (2008) [65]	Medical	Among breast, testicular, and prostate cancer survivors, those who reported work changes (i.e., changes of workplace, prior occupation, work tasks, becoming unemployed, or early retirement) experienced worse subjective health status and more comorbid diseases than those who had no work changes. Norway
Short, Vasey, & BeLue (2008) [81]	Medical	Cancer survivors (breast, uterine, lung, colorectal, prostate, and urinary tract cancer) with comorbid conditions exhibited a higher work disability rate than cancer survivors without a comorbidity. The disability rate was three times higher for males and four times higher for females. About half of all disabled survivors (16 of 30%) reported that their disability was related in some way to their cancer. There was a lower rate of disability for diabetics compared to survivors with new cancers across both genders. USA
Taskila, Marikainen, Hietanen, & Lindbohm (2007) [12] ^a	Medical	Survivors with a comorbidity or prior exposure to chemotherapy most often reported impairment in physical and mental work ability. Finland
Drolet, Maunsell, Brisson, Brisson, Masse, & Deschenes (2005) [58]	Medical	Adjuvant radiotherapy, adjuvant chemotherapy, or invaded axillary nodes did not increase the likelihood of work disability in breast cancer survivors 3 years post-diagnosis. Occurrence of new cancers during the 3-year post diagnosis period increased likelihood of work disability. Canada
Fang, Tasi, Chien, Chiu, & Wang (2004) [60]	Medical	Oral cancer survivors with older age, lower annual family income, more advanced cancer stage, and flap reconstruction had significantly worse Physical Component Summary (of the Short-form-36) and those with lower annual family income, unemployment, and more advanced cancer stage had significantly worse Mental Component Summary (SF-36) compared to Taiwanese and US norms. Taiwan
Taskila-Abrandt, Martikainen, Virtanen, Pukkala, Hietanen, & Lindbohm (2004) [84]	Medical	Lung cancer survivors were the least likely to be employed. Low employment rates were also found among those with leukemia, stomach, and cancer of the nervous system. Finland
Fang, Chiu, Kuo, Wang, Leung, Chen, et al. (2002) [59] ^b	Medical	Absence of comorbidity tended to be associated with a higher health-related quality of life (physical, mental, and social) compared to those with comorbid conditions. Taiwan
Symptoms		
Peuckmann, Ekholm, Sjogren, Rasmussen, Christiansen, Moller, et al. (2009) [79] ^b	Physical	11% of breast cancer survivors stopped working or changed jobs as a result of sequelae related to breast cancer (i.e., chronic pain, others unspecified). Denmark

Table 3 (continued)

Author (Year)	Variables	Findings
Gudbergsson, Fossa, & Dahl (2008) [65]	Distress	In breast, prostate, and testicular cancer survivors, the group who had changes in work due to cancer experienced higher scores of depression and anxiety, lower scores on physical and mental “quality of life,” and higher scores on neuroticism compared to the group of survivors that did not have work changes. Norway
Hansen, Feuerstein, Calvio, & Olsen (2008) [10]	Fatigue	Fatigue was more strongly associated with work limitations among breast cancer survivors, whereas depressive symptoms were more strongly associated with work limitations among non-cancer comparisons. USA
Lavigne, Griggs, Tu, & Lerner (2008) [11]	Fatigue	Fatigue and hot flashes in breast cancer survivors were associated with a decrease in work performance. USA
Feuerstein, Hansen, Calvio, Johnson, & Ronquillo (2007) [61] ^a	Distress	Brain tumor survivors had increased symptom burden (mood, fatigue, cognitive limitations), lower levels of health behaviors, and more negative problem solving orientation when compared to a non-cancer comparison group.
	Fatigue	Depressive symptoms, fatigue, cognitive limitations, and sleep problems were responsible for 65% of the variance in work limitations in both brain tumor survivor and non-cancer comparison groups. USA
	Cognitive Limitations	
	Sleep	
Bradley, Rose, Lutgendorf, Costanzo, & Anderson (2006) [54]	Distress	Cancer survivors who were working full-time reported less depression than homemakers, work-disabled, and retired women.
		Cancer survivors with a work disability had higher levels of distress and depression compared to those who were working full-time or those who worked part-time. USA
Harder, Cornelissen, Van Gool, Duijvenvoorden, Eijkenboom, & Van Den Bent (2002) [68]	Cognitive	In long-term adult survivors with bone marrow transplantation, fatigue was related to absence from work.
	Physical	There was a relationship between current employment and cognitive impairment, cognitive complaints, and self-reported memory problems rated by the neuropsychologist. Cognitive impairments included problems in attention during conversations, paperwork, and verbal and visual memory. Netherlands
Function		
Shin, Noh, Lee, Nam, Park, Ahn, et al. (2009) [80]	Emotional	Poor “existential well-being” among Korean breast cancer survivors was associated with lower monthly income and unemployment. South Korea
Hakanen & Lindbohm (2008) [67]	Emotional	Optimism was strongly associated with work engagement and pessimism was negatively associated with work engagement in breast cancer survivors compared to controls. Finland
Mols, Aaronson, Vingerhoets, Coebergh, Vreugdenhil, Lybeert, et al. (2007) [75]	Emotional	Non-Hodgkin lymphoma patients who were working reported more vitality and exhibited higher mental well-being scores than those who weren’t working. Netherlands
Fleer, Hoekstra, Sleijfer, Tuinman, Klip, & Hoekstra-Weebers (2006) [63] ^a	Physical Interpersonal Emotional	Unemployment and chronic disease (defined by long duration or frequent occurrence) were the strongest predictors of both impaired physical, psychological, and social functioning as well as physical, psychological, and social quality of life for testicular cancer survivors. Netherlands

Table 3 (continued)

Author (Year)	Variables	Findings
Gudbergsson, Fossa, Borgeraas, & Dahl (2006) [64] ^a	Physical Cognitive	Survivors reported significantly lower physical and mental work capacity, which negatively affected work performance. This was related to significantly more somatic diseases in cancer survivors and poorer health in male survivors. Norway
Avis, Crawford, & Manuel (2005) [51]	Physical Emotional Interpersonal	Among breast cancer patients: lower physical and emotional well-being was related to unemployment and missed work days; lower functional well-being was associated with unemployment; and lower total Functional Assessment of Cancer Therapy scores were related to unemployment and missing 3 months of activities post diagnosis. USA
Drolet, Maunsell, Brisson, Brisson, Masse, & Deschenes (2005) [58]	Emotional	Breast cancer survivors were more likely than healthy women to report that they valued work less than they did 3 years earlier (42% of survivors and 26% of healthy controls). Canada
Wettergren, Bjorkholm, Axdorph, Bowling, & Langius-Eklof (2003) [87]	Emotional	For both controls and Hodgkin lymphoma survivors, over 50% placed the most value in family, personal health, work, and relations with other people. Sweden
Harder, Cornelissen, Van Gool, Duivenvoorden, Eijkenboom, & Van Den Bent (2002) [68]	Physical Cognitive	In long-term adult survivors with bone marrow transplantation, absence from work was related to physical functioning. Following bone marrow transplantation, patients showed a decrease in cognitive functioning after treatment (pre-post). Netherlands
Joly, Heron, Kalusinski, Bottet, Brune, Allouache, et al. (2002) [71]	Emotional	Testicular cancer survivors reported lower levels of professional ambition than the non-cancer control group. France
Chan, Ngan, Yip, Li, Lau, & Tang (2001) [56]	Cognitive Emotional Interpersonal	Among gynecologic cancer survivors, those with a job reported improved self-role. China
Work demands		
Carlsen, Dalton, Diderichsen, & Johansen (2008) [55]	Physical	Manual work was a predictor of unemployment for cancer patients (from a heterogeneous group). Denmark
Gudbergsson, Fossa, Sanne, & Dahl (2007) [47]	Physical Cognitive Emotional	Breast, testicular, and prostate cancer survivors showed no difference in job strain compared to controls. Female survivors experienced more job strain than males. Male survivors over the age of 50 experienced more job demands than young male survivors. Norway
Drolet, Maunsell, Brisson, Brisson, Masse, & Deschenes (2005) [58]	Physical Cognitive Emotional	At the follow-up period (3 years after diagnosis), there were no statistically significant differences in the overall working conditions (e.g., hours worked per week, income) between breast cancer survivors and healthy controls. Canada
Taskila-Abrandt, Martikainen, Virtanen, Pukkala, Hietanen, & Lindbohm (2004) [84]	Physical	Cancer survivors in mining, agricultural, forestry, fishery, transportation, and communication were the least likely to be employed compared to their referents of all the occupations assessed. This is likely to be due to the physical demands of these occupations. Finland
Work environment		
Gudbergsson, Fossa, & Dahl (2008) [65]	Job Stress	Among 219 females who had breast cancer and 212 males who had testicular ($n=150$) or prostate cancer ($n=62$), work demands were higher and support was lower in cancer survivors who made

Table 3 (continued)

Author (Year)	Variables	Findings
		work changes due to cancer compared to those who did not change work. Norway
Gudbergsson, Fossa, & Dahl (2008) [66]	Social Climate	Reduced work engagement was associated with increased levels of support and control. Norway
Hakanen & Lindbohm (2008) [67]	Job Resources Social Climate	Social job resources (e.g., social support at work) were related to work engagement in both breast cancer survivors and controls. Finland
Hansen, Feuerstein, Calvio, & Olsen (2008) [10]	Job Stress	Reported job stress did not differ between the breast cancer survivors and the non-cancer comparison group. USA
Lee, Lee, Bae, Kim, Kim, Ryu, et al. (2008) [73]	Opportunities for Promotion	10% of the general population and only 4% of the cancer survivors had reduced opportunities for promotion. Korea
Feuerstein, Hansen, Calvio, Johnson, & Ronquillo (2007) [61]	Job Stress	No difference was found between brain tumor survivors and the non-cancer comparison group on general level of perceived job stress. USA
Gudbergsson, Fossa, Sanne, & Dahl (2007) [47]	Job Stress	Older survivors had higher scores on demands than their controls, female survivors reported lower control and higher strain than male cancer survivors, and older male survivors experienced higher demands than younger ones (effect sizes were small). Norway
Taskila, Martikainen, Hietanen, & Lindbohm (2007) [12]	Social Climate	A better social climate at work and greater commitment to the work organization was related to stronger work ability and reduced risk of impaired work ability for both survivors and controls.
Policies, procedures, and economic factors		Male controls with more support had better work ability, but this was not found in male survivors. Finland
Norredam, Meara, Landrum, Kuskamp, & Keating (2009) [77]	Legal	Female cancer survivors and those with no cancer history did not significantly differ in likelihood of being insured, insurance type, or whether cost of medications was covered.
	Organizational	Male cancer survivors were less likely to be covered for the costs of medications than those with no cancer history. Denmark
Feuerstein, Luff, Harrington, & Olsen (2007) [44]	Legal	Cancer survivors were more likely to file claims regarding job loss and differential treatment related to workplace policies. There was a protective effect for any impairment other than cancer related to discharge from work. Cancer survivors with a comorbid impairment were more likely to file disputes that involved work relationships compared to those with cancer only. USA
McKenna, Fabian, Hurley, McMahon, & West (2007) [74]	Legal	Regarding allegations of workplace discrimination, the charging parties with cancer had a higher likelihood of reporting disputes related to discharge, terms and conditions of employment, demotion, wages, and benefits (insurance and non-insurance).
	Organizational	Disputes by employees with cancer, compared to the general disability population, had an increased likelihood of filing claims against smaller employers (15–100 employees) or those in service industries. USA
Noorda, van Kreijl, Vrouwenraets, Nieweg, Muller, Kroon, et al. (2007) [76]	Legal	Among long term survivors of extremity melanoma, 8% had experienced difficulty obtaining life insurance, 4% were denied life insurance, and in 2% the premium for life insurance was prohibitively high or an extensive health examination was required.

Table 3 (continued)

Author (Year)	Variables	Findings
	Organizational	6% were denied health insurance, and 2% were required to pay a very high premium for health insurance. Netherlands
Drolet, Maunsell, Brisson, Brisson, Masse, & Meschenes (2005) [58]	Organizational	Union membership among breast cancer survivors increased the likelihood of not working 3 years post diagnosis. Canada
Helgeson & Tomich (2005) [69]	Organizational	Among breast cancer survivors, there were no differences related to work experiences compared to a group of healthy women or compared to a group of women who experienced cancer recurrence. The work experiences were listed as positive work experiences (substantial pay increase), negative work experiences (not being offered a new position that the individual was qualified for), or denial of work benefits. USA
Harder, Cornelissen, Van Gool, Duivenvoorden, Eijkenboom, & Van Den Bent (2002) [68]	Organizational Legal	Among adult survivors of bone marrow transplantation, 40% were receiving disability or sickness benefit. Netherlands

Studies were included in multiple categories.

^a Includes information that also relates to the Function category

^b Includes information that also relates to the Health and well-being category

addition, despite the linear appearance of the model, it is possible that non-linear relationships exist as well. Future research needs to be conducted that studies dynamic processes whereby these linkages can be empirically identified. The validation of this dynamic system over time can guide future research and practice [26]. The arrows in the model represent potential relationships.

Health and well-being

The first category in the model considers the health and well-being of the cancer survivor at some point in time. The operational definition of health is based on the World Health Organization's definition, which is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" [27]. The proposed model includes medical, behavioral, and social sub-categories of health and well-being. The term behavioral was chosen rather than "mental" because behavioral health is a broader term that also encompasses behaviors related to health such as sleep, diet, and exercise. Variables within the medical health and well-being category include diagnosis, treatment, co-morbidities, recurrence, and other biomedical variables. Behavioral health includes not only psychological health and well-being but also various health-related behaviors (e.g., smoking cessation, activity). Social health and well-being includes type and quality of social relationships and support.

Symptoms

The second major category of the model includes the presence and severity of symptoms that can accompany cancer diagnosis and treatment and can exist for years following treatment at varying levels of frequency and severity [28]. Symptoms are listed separately from health and well-being because while they co-exist, symptoms can be experienced without a conventional medical explanation [29]. Conversely, individuals can be asymptomatic despite an active disease status [30]. Symptoms and well-being interact. The most prevalent symptoms in cancer survivors include fatigue, cognitive limitations, distress, pain, sleep disturbance, and dyspnea [31, 32]. When using this model to help guide clinical management, it is important to note that the examples provided are not designed to be exhaustive. Other symptoms of cancer and its treatment (e.g., nausea, dry mouth, loss of appetite) are also important to consider within this element of the model. Clinically, it may be sufficient to generate this information through a careful history. However, many of these symptoms are subjectively measured using psychometrically valid and reliable patient reported outcomes [33, 34]. It is important to emphasize that these symptoms may not rise to the level of a given disorder (e.g., a person may exhibit depressive symptoms without meeting the diagnostic criteria for depression).

Function and work demands

The next major category in the model focuses on current levels of function or functional status (i.e., strength, flexibility, aerobic capacity at the time of evaluation). This category includes multiple aspects of function including physical, cognitive, emotional, and interpersonal function in relation to the various tasks required of specific types of work (i.e., aspects of work that may be most demanding or most common). Each of these aspects of function can be multifaceted and will require operational definitions obtained by clinical experience and research.

Work demands are depicted as interacting with functional abilities. The model suggests that various work outcomes are influenced by the discrepancies between an individual's functional capabilities and the work demands with which they are faced. The model proposes that the person's functioning should align to some degree (not 100%) with the work demands in each domain. It is important to emphasize that the model does not call for a functional capacity evaluation. In fact, years of research indicate that this specific evaluation approach proposes a one-to-one relationship between physical capabilities and physical work demands. However, data have emerged over the years indicating that many other factors enter into this discrepancy and its relationship to work outcomes. It is clear that this assessment approach does not predict ability to work with musculoskeletal disorders [35]. The proposed model delineates multiple variables that can impact the discrepancy between capacity and demands while focusing on the broad abilities that may be needed to meet the diverse demands of the work.

To account for the observation that work demands and capacities can vary within and across days [36], the model calls for innovative measurement that allows for dynamic assessment of the four domains of functioning. This assessment should be both multivariate and dynamic at a given time and over time. At this point, we cannot rule out the potential importance of such interactive relationships between variables. They have not been adequately tested but represent a much more individualized approach to return to work and work accommodations than is currently possible.

Considering the role of other factors in the model, a discrepancy between functional capabilities and work demands could mean that the demands are too high for a worker's current capabilities, causing overload for certain job tasks. Alternatively, work demands might not be high enough for a worker's ability, leading to boredom and reduced productivity. It is a common observation in vocational rehabilitation that not all jobs with similar titles or classifications have an identical set of demands. This

component of the model does not place the burden of optimizing work function exclusively on the worker through rehabilitation to improve capacity. Rather, it suggests considering rehabilitation as a viable option but also in the context of modifying workplace demands both at an individual level (e.g., workplace accommodation) and systems level (e.g., organization, policy) [26]. Combining an individual perspective with a broader systems perspective provides options at both levels to help prevent these problems from occurring or recurring in the future as well as managing the problem at this point in time.

The human factors and ergonomics professions are well aware of the discrepancies between work demands and worker capabilities from a multidimensional perspective. Although typically focusing on the biomechanical perspective of these interactions, these applied scientists use various methods to evaluate and reduce the impact of discrepancies on work performance at a work task level (i.e., job analysis, redesign of problematic work tasks) [37]. Some of the knowledge and work in the area of human factors and its long history with musculoskeletal disorders may be retrofitted for the problems of cancer and work [38]. It is important to reemphasize that the current model proposes that, when discrepancies are observed, it is important to consider and modify each of the problematic dimensions of function that can impact the execution of essential job demands [39].

Work environment

The work environment can also impact work outcomes as indicated in the model. This category includes well-defined external measures (e.g., noise levels) as well as worker's perceptions of the workplace (e.g., job stress, flexibility from supervisor, opportunities for promotion, organizational and social climate, and support of co-workers). An example of the work environment influencing work outcomes would be an agreement between employee and employer over a change in duties or hours [40]. Another example of the involvement of the work environment is providing high levels of tangible workplace support (i.e., paid time for medical appointments, an offer of a return to work meeting, and reduced hours) for employees with cancer [41]. This can assist in the return to work transition. Since workplace support is important for a successful return to work and some workplaces do a better job of providing a supportive work environment than others, this needs to be considered and interventions should be designed and evaluated that improve the workplace environment for cancer survivors [42]. As Fig. 2 depicts, this category can be related to the function-work demand relationships but can also be directly related to organizational change at a broader systems level.

Policies, procedures, and economic factors

Policies, procedures, and economic factors are the final broad category in the model. The model does not indicate arrows connecting policies, procedures, and economic factors to other variables in the model for the sake of visual simplicity. However, these factors can influence and be influenced by each of the other categories within the model. For example, policies may influence the social context and work environment or climate, which could have a major impact on work outcome. While the factors in this category operate at a level on which the individual cancer survivor and clinician often has relatively less impact, it is important to be cognizant of how these factors can play a role in a cancer survivor's work outcome.

The clinician should understand how these factors can influence workplace expectations, the structure of the workplace, demands on the worker, resources provided to the worker to remain at work, or benefits that are available for work disability. Providers do not need to become knowledgeable of all the relevant policies. Human resource departments in large companies or the individual who manages benefits in small businesses can assist a cancer survivor with health and work related matters. A current problem or challenge need not be left to "work itself out," as such a passive response can trigger mistrust and unfair practices. Aspects of the health care system, such as limited access or low quality of care, can also influence work outcomes often by failing to optimally manage health. These factors should be considered by the evaluation team and directly addressed if necessary.

There are also cancer survivors who are back at work and experience workplace problems, such as discrimination related to cancer, when returning to [43] or remaining at work [44]. The sources for many of these problems could simply be the lack of communication among all the parties; however, the factors that contribute to these problems need to be studied to provide a better understanding of this matter. Many of the problems might stem from an institutional policy that can be at odds with workplace laws.

Work outcomes

After diagnosis and treatment for cancer, an individual may experience a number of adverse work outcomes. Different aspects of work are considered outcomes in this model. These work related outcomes include: return to work (i.e., whether a person returns to full time work following diagnosis or treatment), work ability (i.e., an individual's psychological, physical, and social means to engage in

work [65]), work performance (i.e., absenteeism, perceived impairment while at work, level of productivity, efficiency, estimation of unproductive time at work [45]), and work sustainability (i.e., remaining employed for a period of time).

The model does not presuppose the importance of one outcome over another. However, the interests and motivations of the specific stakeholder asking the question often determine the question and related outcome of interest. An outcome is determined as a function of the specific research or clinical question asked. For example, if the focus of the study or intervention was on the factors related to participation in work following a leave of absence, then return to work would be the outcome of interest. In contrast, if the goal was to develop an intervention for improving work output in a situation where the cancer survivor indicated a great deal of frustration in his or her pattern of getting things done (i.e., pace of work, perceived or actual quality) at a level similar to before diagnosis or treatment, work productivity might be the outcome of interest. If after a few years at work the cancer survivor found that he or she was experiencing high levels of fatigue or pain that made it difficult to work, and work was a desirable outcome for the individual, efforts might be directed at increasing the likelihood of maintaining sustainable work.

A recent epidemiological study highlights the importance of feedback loops among workers' perceptions of their workplace, perceived health, and work sustainability [46]. This prospective study collected data 7 years prior to and following retirement. An increase in the likelihood of retirement occurred when the employee perceived not only their health but their job was "less than ideal." Seven years after retirement, there was a steep improvement in perceived health in the group with both health and job concerns prior to retirement. While this unique study was not specific to cancer, it provides additional support for the belief that sub-optimal perceptions of both health and work environment can impact work retention.

When considering work in cancer survivors, it should be remembered that paid work is only one of many life options. There are multiple factors that enter into the decision to work with a chronic illness despite challenges. This model focuses on those cancer survivors who indicate that return to work or sustaining a working life is a priority. It is also important to mention that at this point in development of the area of cancer and work, any model cannot possibly list all possible variables that may contribute to the various work outcomes considered. We focused on the current literature specific to cancer survivors and work that met the inclusion criterion for the review.

Using the work and cancer model to guide questioning and intervention

The following case illustrates how the model depicted in Fig. 2 can help the provider query areas that are potential barriers to optimal work function.

Case: BR

Background

BR is a 40 year old Latina breast cancer survivor who completed primary treatment 15 months ago. She was diagnosed with Stage IIA invasive ductal carcinoma on the right side and was treated with surgery, chemotherapy, and adjuvant hormonal therapy. She has been working for 10 years at the same employer and returned to work a few weeks after completion of her primary treatment. BR is a single mother of two and must work to support her family, maintain health insurance, and pay her medical bills. She indicated that work also provides a sense of purpose, identity, and a social network.

BR reports episodic fatigue that peaks at least once per week, pain in her right shoulder and arm at a level of 6 out of 10 maximum, and impaired memory and organizational skills at work, which is worsened by job stressors including an inflexible schedule, conflicts with co-workers, and pressure to increase sales numbers. Her current position, which she had held for 2 years prior to diagnosis, is that of a mid-level manager/supervisor in an organic produce distributor.

Work limitations

BR is responsible for a region that includes 240 grocery stores and 15 sales representatives to service the stores. She reports that her episodic fatigue, pain in her arm on the right side where she had surgery, and cloudy mental state are exacerbated when under pressure to complete work tasks. This has reduced her ability to complete tasks as quickly as she had in the past. Negative comments regarding the speed of completion of work tasks from her supervisor makes her question her job security. BR's uncertainty regarding her job stability, particularly given the economic downturn, and the uncertainty of workload from day to day further worsens her problems and maintains her high levels of distress. Prior to the cancer diagnosis she was a top producer and received the highest possible ratings on her annual job performance evaluations.

Application of the model

Consider each component of the model to identify specific problem areas where some type of assistance may help. To illustrate, consider the following:

1. Characteristics

While demographic characteristics are non-modifiable, some of these variables may put BR in a position of heightened risk for adverse work outcomes. As a female, she is likely to experience heightened job strain in the workplace [47]. Her Latina background may also influence her access to referral sources, trust of Caucasian health providers who may be managing her case, as well as her response to pain and job stress at work.

2. Health and well-being

BR is having a difficult time getting her recommended amount of sleep and exercise and further reports that she is "stress eating" food that is high in fat and refined carbohydrates. She feels socially isolated since the majority of her social interactions are with her young children, who cannot fully support her emotional needs, and with her coworkers, with whom she does not feel comfortable confiding her personal concerns. BR's scarring following surgery created body image concerns which she believes will hinder her ability to find a new partner. Her elevated HDL, triglycerides, and blood pressure reveal that she has metabolic syndrome, increasing her risk for developing other medical conditions such as Type II Diabetes, which could further impact her functioning at work.

3. Symptoms

BR reports experiencing low energy, pain, impaired working memory, and difficulty in organization and performing tasks at work. These problems have been worsening and are now interfering with BR's ability to complete these tasks as well as she did before her diagnosis of and treatment for cancer.

4. Functional capabilities in relation to reported work demands

BR now works 2–3 more hours per day than she did before her cancer diagnosis. In an attempt to meet her variable work demands, she is pacing herself throughout the day and making certain that she takes advantage of breaks. However, despite her additional work hours, BR's fatigue prevents her from performing at her previous level. Embarrassed about her difficulties and worried about failing to meet the expectations of her supervisor, BR has felt unable to approach her supervisor with concerns. Since her supervisor is unaware of the specific difficulties she faces, her work demands (sales numbers, number of customers, etc.) have remained constant while her capability has decreased.

5. Work environment

BR feels as though her employees are talking behind her back about changes in her work performance and

the effects of her work performance on their own workloads. Although her supervisor seems supportive, she is unsure if the support would continue if she were to be honest regarding her work task related limitations.

6. *Policies, procedures, and economic factors*

Her employer is large enough to be bound by the requirements of the Americans with Disabilities Act (ADA) and ideally provide “reasonable accommodations” to BR if she were to request them. However, her annual bonus, which she relies on as part of her yearly income, is contingent upon the sales figures of her region, which could be hurt by her impaired performance.

At present, there are no evidence-based guidelines to assist with the management of these problem areas in cancer survivors. However, there are many options that can evolve from such a comprehensive evaluation using categories where problems are reported or observed. For now, people with a wide range of chronic illnesses experiencing problems at work have received help from various providers and work related interventions such as vocational counseling, workplace accommodations, and job redesign. These approaches need controlled investigations to determine their effectiveness.

Discussion

The proposed model provides a framework to conceptualize barriers to optimal work outcomes in those cancer survivors who desire paid employment but who are experiencing problems related to work. Based on current knowledge about cancer and work disability prevention, this model presents a set of testable hypotheses in the context of prevention, clinical care, or case management. The model brings clinicians’ attention to important areas that can help focus intervention efforts for individual cancer survivors. By identifying these problem areas and working to provide solutions, it may be possible to improve work outcomes in a systematic and cost effective way. The model and its impact need to be empirically supported across cancer types and work outcomes. It is also important to test the clinical outcome of specific intervention options that can evolve from a better understanding of the processes described in the model.

The current model was developed with a focus on the potential management of cancer survivors at work. We highlighted areas from the literature related to cancer and work in order to generate a model that could assist in the clinical evaluation and primary, secondary and tertiary prevention of work disability among cancer survivors. This model focuses only on the consequences of cancer or its post treatment sequelae and ongoing interactions that facilitate work outcomes. Although occupational exposures

may play a role in causing cancer, information related to etiology of cancer and occupational cancers is beyond the scope of this paper.

The model includes features found in the work disability prevention field [20]. These models are generally multidimensional, the factors in the model are interactive, and the process of disability development is sensitive to the time since onset of illness or injury. Whether a cancer-specific model or a more generic model of work disability across illnesses is more valid should be addressed in further research. The validity of chronic illness-specific models of work disability remains to be empirically determined. Cancer survivors can experience aspects of recovery that are both common in other illnesses and those that differ such as the threat of a life-threatening cancer recurrence or new cancers, lack of evidence-based guidelines to help identify and manage the many long-term and late effects that can arise, and even different patterns of workplace discrimination than other illnesses [44]. Whether these unique aspects differentially impact work outcomes in cancer survivors or people with chronic illness in general remains to be determined.

Several years ago the World Health Organization (WHO) developed an integrated model of disability [48] that includes medical, functional, and psychosocial characteristics of the patient. In the past, the WHO model has been primarily focused on the impairment element of disability in general. It has not addressed work specific functional discrepancies with demands of work and the work environment as playing a role in work disability. The WHO is working on making their model more applicable to problems at work [49], and elements of that effort may be useful to consider in the context of this more illness specific context.

As with any review, our methods have some limitations. While the literature reviewed included 45 papers, the authors did not explore references cited in these papers and it is possible that some studies were not included. The other potential limitation to this review process is the absence of a second independent reviewer to ensure reliability of inclusion criteria. We also eliminated qualitative studies and any study that did not include a comparison or control group.

Although the literature that was considered met a set of rigorous methodological criteria, the studies were predominantly cross-sectional. Therefore, most elements of the model are empirically supported by observed associations and not causal inference. Prospective studies were limited and there is a clear need for such studies in this area. Other limitations of the literature included modest sample sizes, variability in power to detect significant findings, variability in time frames from treatment termination to study onset, variability in definitions of independent and dependent

dent variables, and failure to address all cancer types. Caution generalizing across cancer types is justified at this point.

There is a need to develop effective and efficient cancer specific approaches that identify and target areas related to many dimensions of work disability for cancer survivors over the trajectory of the illness. These findings apply to those who choose or need to work post cancer diagnosis and treatment. This model should assist ongoing efforts to empirically identify problem areas, evaluate current cases, utilize evidence-based interventions from other areas within the work disability field, and ultimately develop new cancer survivor specific interventions and research.

Acknowledgement In preparation of this model the authors received many thoughtful comments. We want to thank Cathy J. Bradley, PhD, Angela de Boer, PhD, Patricia A. Ganz, MD, Patrick Loisel, MD, Glenn Pransky, MD, MOcc, Izabela Z. Schultz, PhD, William Shaw, PhD, Taina Taskila, PhD, and Jos Verbeek, MD. The insightful feedback received greatly helped the authors think more clearly about this problem. We thank them for their time. However, the authors of this paper are solely to blame for omissions or faulty thinking.

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