Understanding acceptability of and engagement with web-based interventions aiming to improve quality of life in cancer survivors- a synthesis of current research

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Abstract

Purpose

This review sought to summarize existing knowledge in order to inform the development of an online intervention that aims to improve quality of life after cancer treatment.

Methods

To inform our intervention, we searched for studies relating to web-based interventions designed to improve QoL in adults who have completed primary treatment for breast, prostate and colorectal cancer (as these are three of the most common cancers and impact a large number of cancer survivors). We included a variety of study designs (qualitative research, feasibility/pilot trials, randomised trials, and process evaluations) and extracted all available information regarding intervention characteristics, experiences, and outcomes. Data were synthesised as textual (qualitative) data and analysed using thematic analysis.

Results

Fifty-seven full text articles were assessed for eligibility and 16 papers describing nine interventions were analysed. Our findings suggest that cancer survivors value interventions that offer content specific to their changing needs and are delivered at the right stage of the cancer trajectory. Social networking features do not always provide added benefit, and behaviour change techniques need to be implemented carefully to avoid potential negative consequences for some users.

Conclusions

Future work should aim to identify appropriate strategies for promoting health behaviour change, as well as the optimal stage of cancer survivorship to facilitate intervention delivery.

Clinical Implications

The development of web-based interventions for cancer survivors requires further exploration to better understand how interventions can be carefully designed to match this group's unique needs and capabilities. User involvement during development may help to ensure that interventions are accessible, perceived as useful, and appropriate for challenges faced at different stages of the cancer survivorship trajectory.

Background

The number of cancer survivors is increasing as a consequence of earlier diagnoses and advances in treatment(1). The period following primary treatment is a critical time in the cancer trajectory, often characterised by ongoing symptoms, and poor health (2, 3). Prolonged symptoms lead to ongoing challenges for cancer survivors and delay return to daily routine (4). The Internet is increasingly being used as a resource by cancer survivors (5) as web-based interventions can provide an efficient method of improving support (6). These interventions can incorporate multiple behaviour change techniques, while overcoming obstacles to seeking support after cancer such as time, mobility, and geography (7). We-based interventions for cancer patients have been associated with improvements in quality of life (including psychological and physical well-being)(8, 9). We sought to synthesise the growing evidence base that relates to web-based interventions directed at improving quality of life in cancer survivors, in order to inform the development of an acceptable and feasible new intervention for breast, prostate and colorectal cancer survivors. The intervention is focused on these cancers as they are three of the most common cancers and impact a large number of cancer survivors (1).

Previous reviews of interventions for cancer survivors have focused on questions of effectiveness, by reviewing controlled trials (10-12). However, much of the literature on web-based interventions for cancer survivors reports early stage research, consisting mainly of intervention development and feasibility studies. Systematic reviews are useful to synthesise research findings (13) but are most appropriate when a strong evidence base (of homogenous datasets) exists (14, 15). Reviews of heterogeneous, complex interventions frequently conclude that the evidence is 'weak' or 'mixed' (12, 16) and often fail to address intervention usability and acceptability(13). It is important to understand how an intervention works in and suits a given context (15, 17). Integrating and implementing all currently available evidence on web-based interventions for cancer survivors, rather than simply definitive trials, could inform decisions regarding intervention design and delivery (17).

Systematic reviews have started to incorporate a wider range of study designs (e.g. qualitative research) to address questions relating to intervention processes, and acceptability (14, 18). Some review approaches, such as Intervention Component Analysis (ICA) can be used to interpret variations in findings of different interventions, and allow comparisons to be made across studies with similar objectives, but which may be different in many respects (19). Thematic Synthesis (13) has been used to evaluate intervention need, appropriateness and acceptability. The method adheres to key principles of systematic reviews(18), using rigorous and explicit methods to synthesise primary research, while incorporating the experiences and views of intervention participants. Findings from ongoing or qualitative research may not lead to firm conclusions about the effectiveness of the intervention, yet may help researchers to identify important issues relating to trial feasibility for future work (20). Identifying components in a multicomponent intervention that are likely to be necessary for trial implementation [2] can inform a novel, composite online intervention that meets the needs of cancer survivors (21).

In this review, we drew on thematic synthesis (13) and ICA(19) to extract and analyse data from a range of studies with different designs. The research question was "which features of web-based interventions for breast, prostate and colorectal cancer survivors are important for acceptability, feasibility, engagement, and effectiveness?"

Methods

To inform decision making for intervention development purposes in a timely fashion, we followed rapid review methods (22-25) to identify studies of interest. We used thematic synthesis for analysing the data, also drawing on approaches used in ICA(19). We adhered to the AMSTAR: A MeaSurement Tool to Assess Reviews criteria (28). (See Appendix A. further details).

Search

Inclusion and exclusion criteria are outlined in Table 1. The research question and search terms were defined using PICOS (Population, Intervention, Comparison, Outcome, Study Design) criteria (26). We sought to identify qualitative and quantitative studies relating to web-based interventions designed to improve QoL in adults who have completed primary treatment for breast, prostate and colorectal cancer Interventions that included participants with a variety of cancer types were included, if at least one of the three cancers of interest were represented in the sample. These interventions were included as they generally focused on quality of life issues deemed likely to be shared across all cancer types.

The search was undertaken in May 2016 using electronic bibliographic databases (see Appendix B. for search strategy).

Initial searches and screening of titles and abstracts were conducted before full-text copies were screened for inclusion or exclusion. TC and KS screened the papers for eligibility, with each author recording the reason for rejection of excluded studies. Differences between the two reviewers were resolved by discussion, with the involvement of a third reviewer if necessary (KB).

Data Extraction

All available information regarding intervention characteristics, experiences, and outcomes was extracted from the Results and Discussion sections of the papers, using a standardised data extraction form (See Table 3. for summary of data extracted).

Data were extracted electronically and treated as textual (qualitative) data. This included all text under the headings 'procedures' or 'methods', 'findings' or 'results' and 'discussion' or 'conclusions'. Authors' interpretations in the Discussion were included, as these can be considered qualitative evidence that may provide insights about the perceived strengths and weaknesses of interventions as well as the experience of development, use and implementation(19).

Quality Appraisal

To assess quality, we used the best practice quality appraisal tools for each different study design included in our study. As there were a number of different designs, we used different tools, including the Critical Appraisal Skills Programme (CASP) quality assessment tools for quantitative and qualitative studies (27) and the Critical Appraisal of a Survey tool developed by the centre for Evidence-Based Management (28).

TC and KS tabulated quality assessments of the studies based on the categories used in the CERQual (Confidence in the Evidence from Reviews of Qualitative research) Approach for assessing the confidence of evidence from reviews of qualitative research (29) (See Table 2.). We included studies regardless of study quality, but provided quality assessment to assist the reader to determine the relative quality of each study included in the analysis (See Table 2.).

Synthesis

We aimed to develop a description of the relevant features and outcomes of the interventions (13, 19, 30, 31). Coding and analysis were carried out with iterative in-depth discussion of emerging themes between the co-authors. We conducted line-by-line open coding of the method, findings,

and discussion sections of included studies. One paper deemed to be of high quality (*RESTORE* (32)) was used to develop a coding manual and we tested its reliability on two other papers. A sample paper was checked by a third co-author (KB) to ensure coding consistency. The remaining texts were coded, with authors discussing additional codes where any novel concepts were identified (13).

Analysis

Codes were organised into descriptive themes (13). Descriptive themes remained 'close' to the reported findings. This process was data-driven and did not aim to fit the data to any particular research question.

Identified clusters of descriptive themes were used to generate analytical themes. The definitions of each of the themes can be seen in Appendix C. Analytical themes were constructed based on their relevance to the research question that we had outlined a priori. This process allowed us to derive our outcomes of interest from the data, based on pre-specified aims of the research. Analytical themes are used to facilitate the development of new interpretive explanations or hypotheses(13). Our analytical themes grouped the descriptive themes into (i) outcomes and (ii) factors that might influence outcomes. We then engaged in a process of mapping these influential factors onto the outcomes. This allowed us to explore the relationship between them, in order to identify which features of web-based interventions impact each of the individual outcomes.

Results

Characteristics of papers and interventions

The PRISMA chart (Figure 1) shows the number of papers screened and reasons for inclusion/ exclusion. In cases where multiple papers relating to the same intervention were included, each paper was identified by the name of the intervention. In total, 16 relevant papers pertaining to nine interventions fulfilled all eligibility criteria for inclusion. Further details can be seen in Table 3.

Three trials focused on multiple health behaviour changes; physical activity and diet. These were the *WSDEI (Health Planner)(33)*, *Survive and Thrive* (34, 35)and *Kanker Nazorg Wijzer (KNW) (36, 37)* trials. Two trials (*RESTORE* (32, 38-40) and *Health Navigation(41)*) addressed fatigue in cancer survivors. *BREATH* (42, 43)and *STRIDE* (44)also specifically targeted particular outcomes (i.e. distress and physical activity). The *Oncowijzer* (45, 46) and *Prostate Cancer Education and Resources for Couples (PERC)* (47)studies focused on cancer survivors and their partners during the transition into survivorship (see Appendix B for full study descriptions).

Themes identified in this review

We identified 28 descriptive themes which we grouped into five analytical themes (see Fig 2). The first four themes addressed aspects of intervention designs and implementation of web-based interventions. The themes were:

 i. Participant factors
 ii. Characteristics of the online intervention
iii. Techniques used to change behaviour
iv. Preferred features of web-based interventions

These themes were seen as key factors that appeared to potentially influence the fifth analytical theme:

v. the outcomes discussed in the papers including uptake, adherence and attrition, engagement, feasibility, efficacy, positive behaviour change and acceptability of the interventions.

To address the aims of the review, we present our analyses below in terms of how each of the first four themes appeared to relate to each of the outcomes discussed in the papers. In reporting our findings, we have illustrated each concept using the name of the study it originated from, but also in terms of the type of information source from which the code emerged. Codes derived from statements by study authors were marked with "Au" and participant sources were identified as "Ps". Quantitative evidence or statistic-based findings were identified with "Q" (i.e. Au, Ps, or Q).

Uptake

Uptake included data concerning comments regarding recruitment, as well as patterns observed by the study authors. Individuals participated in the interventions due to perceived unmet care needs, personal interest, and motivation (Au) (35, 39, 44, 46, 47). Characteristics of those who did not take up the intervention were often not recorded.

Technology was seen as a means of potentially increasing access to supportive care for those who cannot (or prefer not to) engage in traditional care, particularly those with sensitive symptoms and illness issues (Au; Ps) (32, 39, 47). Intervention timing may influence uptake, with some authors recommended preparing for survivorship before treatment and continuing soon after completion(Au)(46). In *RESTORE* participants described the timing of participation (from 3 months post-treatment) as 'about right', with participants at least one year post-diagnosis indicating they would have preferred access sooner (Ps;Q)(32, 39). One participant suggested that after a certain stage, the information may be less beneficial: "*I suppose it's also that sense of wanting to kind of move on from it as much as possible…it would be a daily reminder*"(Ps) [38; pg. 6]

Adherence and attrition

Commonly reported reasons for attrition included being busy, cancer recurrence (33, 41), family death, comorbid physical problems, and family illness (Q;Au) (41, 47). Demographic predictors of dropout included factors such as male gender, lower income, and higher levels of distress (Au;Q)(35, 39, 43, 47).

Higher attrition in the online intervention arms may have been due to participants struggling with the web-based nature of the trial (Au;Ps) (32, 33, 39, 45). Some authors suggested that accessing the intervention added burden and/ or required routine adjustments (Au; Ps) (32, 39, 45). However, some studies reported lower levels of attrition than average for online trials for cancer survivors (Q;Au) (33, 41, 47) (37). This was attributed to participants' motivational readiness to engage (Au) (33, 41) and the relevance of the content (Au) (33, 37, 47). Other reasons suggested were convenience because participants were able to access the intervention at their own pace, when it suited them (Au) (33, 37, 41, 47) and the ease of use an accessibility of the content (Au) (33, 37, 41, 47).

Engagement

Web-based interventions allow researchers to identify patterns of use, and how these may be related to outcomes (Au) (32, 35, 37, 45, 48). Additional research to better understand these processes was recommended (Au) (32, 35, 37, 45, 48). Lower levels of engagement may be linked to some participants experiencing an early effect, making further use of the intervention redundant (Au) (48). However, generally, evidence suggested that participants who engaged more with the interventions appeared to get the most benefit (Q) (32, 35, 37). Authors highlighted the importance of actively motivating participants to engage with the online intervention content, for example using prompts and reminders (Au) (35). For example, usage in the *BREATH* intervention varied considerably and logins were on the day the weekly reminder was sent (Q)(48).

Participants appeared to engage more when they reported unmet needs, lower self-esteem, and social support needs (Au;Q) (45, 48). Participants often chose to access content pertaining to

physical and social consequences of cancer, returning to work, and communicating with others (Au;Ps;Q) (34, 35, 46). Other cited factors for engagement included computer literacy and socio-economic status. High usage rates in the *PERC* trial were deemed encouraging by study authors, particularly because the intervention targeted older adults (Au) (47). The exclusion of certain groups (e.g. limited computer literacy; elderly) was a concern for many authors (Au) (32, 33, 39, 41, 45).

Web-based interventions did not appeal to all, and some individuals did not ever access the intervention (Au; Q)(45). Reasons for not fully engaging included illness burden, perceiving content as irrelevant, not useful, or not required (Au; Ps)(33, 44). Barriers to using these interventions included glitches and problems with functionality (such as difficulties logging on; passwords being refused or forgotten) (Au;Ps) (32, 39).

Feasibility

Web-based interventions were seen as a feasible approach to providing supportive care after cancer (Au)(33, 35, 37, 41, 43-45, 47) and were considered particularly beneficial for those who have limited access to supportive care (Au) (35, 44, 47). Ease of participation was an important facilitator of engagement and participants required low levels of assistance to use the interventions (Au; Q)(32, 33, 35, 37, 41, 43-45, 47). Easy to use, interesting, informative, and comprehensible interventions were found to be feasible (Au) (32, 35, 37, 45, 47). Accessibility appeared to be improved by involving stakeholders during intervention protocol development, and end users during usability testing (Au) (32, 36, 37, 39, 43, 45, 47).

Web-based interventions were designed to be incorporated into participants' lives easily, yet some required additional work and/or routine adjustments for participants (Au) (33, 35, 36, 38, 41, 44, 45, 47). This was particularly difficult when the participant had external burdens (e.g. competing demands such as family and work commitments, etc.) or were feeling unwell (e.g. experiencing pain or fatigue)(Au;Ps) (39, 44). Dealing with technical difficulties, and completing fatigue diaries were sometimes cited as burdensome by participants (Au;Ps;Q) (39, 44, 47).

Efficacy

In many cases, due to the exploratory nature of some of the trials, the limited data, small sample sizes, or lack of a comparator group meant that it was not possible to draw firm conclusions about the efficacy of these interventions (41, 43, 44, 47).

Satisfaction

User feedback was sometimes used to improve the intervention. Participants displayed a preference for content chosen by users who contributed to the design of the intervention (Au;Q)(45); (Au) (39, 47). Participants also liked convenient and readily available web-based interventions that had content that was clear, novel, and well organised (Au;Ps;Q) (33, 35, 39, 41, 44, 45, 47). In some studies, specific content was recommended but participants could select topics that had a higher priority for them (Au) (35, 36, 45). Individuals liked being able to choose the elements of the intervention that they engaged with (Au;Ps)(37, 44, 45), which was seen as a means to reduce information overload (Au) (36, 38, 41, 44, 45, 47).

Findings were mixed regarding the use of in-person support. Social networking components (e.g. webmail and discussion boards etc.) were perceived as useful (Au; Q; Ps) (34, 35, 44). However, participants differed in the extent to which they engaged with social networking features (Au; Q)(34, 35, 44). In some trials, participants preferred to read posts rather than to comment themselves. Others indicated that these features did not interest them (Ps) (34, 35, 44).

Many individuals considered web-based interventions superior to offline comparators (Ps) (32, 39). Participants appreciated the ability to access straightforward information and valued material that

addressed relevant issues such as feeling guilty, healing, achieving normality, and fears regarding recurrence (Ps; Au;Q) (32, 39, 45, 47). However, others found the interventions impersonal, simplistic, and vague (Q)(44, 45) and suggested incorporating more detailed or cancer-specific information and practical advice, as well as signposting to resources (Au; Ps) (39, 43, 47). Some participants showed a preference for offline media, and/or struggled with using an online intervention (Au;Ps)(32, 33, 35, 39, 44, 45, 47). Authors recommended that web-based interventions should be part of a multi-modal care model, supplemented by other forms of post-treatment care (e.g. informative brochures, consults with a psychologist etc.) (Au)(33, 39, 42, 47).

Positive behaviour change

Information provision was a commonly used strategy to promote behaviour change (Au) (32, 36, 37, 45, 47). This included signposting to existing supplementary support resources and resources intended to facilitate follow-up conversations with healthcare professionals (Au; Ps) (32, 37, 43, 47). Established national and international guidelines informed the content of many interventions (Au) (32, 33, 35, 37, 41, 44, 47). Other interventions were based on modified versions of pre-existing interventions (Au) (35-37).

Goal management prompted participants to prioritise activities, recognise limitations, and engage in self-reflection about lifestyle and behaviour and was widely regarded as motivating, (Au; Ps) (32, 34, 36, 37, 39, 41, 44). *STRIDE* included step goal approach based on goal setting theory, which promoted goals that were perceived as attainable with respect to the individual's capacity. This reduced feelings of guilt on days participants felt unwell (Au; Ps) (44).

Self-monitoring helped participants to better recognise symptom patterns, reflect on their progress, increase personal accountability, and develop self-awareness (Au;Ps) (33, 39, 41, 44). However, diary keeping was sometimes difficult to incorporate into daily routine (Au;Ps)(32, 39). Behaviour feedback on progress potentially increased perceived self-efficacy (Au) (33, 35, 39, 47).

Action planning was used in some studies to improve motivation and may positively influence changes in health outcomes (Au;Q) (32, 33, 35, 41), but could sometimes be problematic (see 'Negative consequences for some users' below).

Negative consequences for some users

Some authors did not consider any adverse events as attributable to the study (Au) (32, 41). However, in the *RESTORE* trial some users considered the content of the intervention to be more suited to those undergoing treatment and therefore an unwelcome reminder of their cancer (Au;Ps) (39). The authors of the *Survive and Thrive* trial found that attempting action planning and failing led to reduced activity levels in some cases (Q) (35). Action planning strategies may not suit those who continually fail to complete their action plans (Au)(35). Some couples in *PERC* reported decreased relationship satisfaction and communication about cancer (Ps; Q)(47), with some individuals reporting increased sexual dysfunction over time (Ps;Q)(47). Participants may have found it difficult to adjust to novel ways of relating to each other: the intervention may have introduced concepts and ideas that were different to their long-standing relationship and communication patterns, leading to participants finding it challenging to talk about sensitive topics they may not have discussed before (Au) (47). In the *BREATH* study one woman was admitted to a psychiatric clinic (Q)(43). The authors considered this as a serious adverse event (Au) (43). Further, a pattern emerged where more high-distress survivors in the intervention group showed a clinical deterioration (Q) (43). High-distress Breast cancer survivors may need a more intensive intervention than *BREATH* (Au) (43).

Discussion

The aim of our review was to synthesise findings from early research on web-based interventions for post- treatment cancer survivors in order to inform intervention design. For our analysis (see Fig 2.) we grouped together a variety of reported outcomes that were potential indicators of the likely success of the interventions we reviewed. The theme of 'outcomes' referred to not only trial efficacy and behaviour change but also participant uptake, engagement, adherence, and satisfaction. The potential for the interventions to be associated with negative consequences for some users was also considered as an important potential trial outcome. We then examined how these outcomes were related to, or impacted by, commonly reported factors that might influence the results of (or conclusions reached about) a trial. These were grouped into four themes: the characteristics of participants (e.g. motivation and usage patterns); trial characteristics (e.g. design and procedures involved); techniques used to change behaviour; and features of web-based interventions that were preferred by end-users (e.g. perceptions of the interventions as accessible and easy to use).

Our findings highlighted the importance of matching the intervention to the unique characteristics of participants. Autonomy and choice is particularly important for cancer survivors given their idiosyncratic needs that can vary greatly during the post-treatment period (45, 49, 50). Considering participant preferences is likely to be a key factor in the successful implementation of web-based interventions (51). User-centred approaches can help intervention developers to identify intervention features which are likely to be most acceptable and persuasive to appropriate intervention users (51).

Identifying and recruiting the appropriate target sample into the trial is likely to be a crucial part of intervention planning so that the interventions or their content are not perceived as irrelevant, unnecessary, or vague. User characteristics that may impact interventions include age, experience using computers, or ability (52). However, we found that older age was not always a barrier to use. This was surprising, as some research has indicated that factors such as impatience, physical and mental limitations, mistrust, and time issues may impede use in older people (53). Some recent reviews in non-cancer groups have concluded that web-based interventions are likely to have potential in an older population (54-56), due to increases in the of use electronic devices in this group (57).

Our findings were largely consistent with non-cancer specific reviews that have suggested that efficacy of web-based interventions can vary due to factors including the timing of the interventions, targeting the wrong patients, or using an unsuitable mode of delivery (58, 59). However, our analysis identified specific issues that may be useful to consider when designing interventions for this group. For example, the studies reached inconsistent conclusions about whether content was more suitable to individuals with a current diagnosis or soon after treatment, or those at later stages of survivorship. This indicates that content may need to be tailored to stage-specific needs of those at different stages of the cancer trajectory. Further, it was unclear whether social networking features provide any added benefit. Web-based interventions are likely to function effectively without social networking components and with relatively little input from researchers or clinical staff (60).

The findings of this review add to the literature on the use of behaviour change techniques such as self-monitoring of behaviour, planning, goal setting and review, and feedback on performance (61-63). In the interventions we assessed, self-monitoring and action planning seemed to be associated with positive behaviour change in many cases. However, these techniques occasionally proved difficult to incorporate into routines due to conflicting priorities after cancer, and even led to deleterious consequences in cases where participants failed to change behaviour. The selection of techniques to change behaviours should be appropriate to the characteristics of those participating in the trial, in order to avoid causing inadvertent harm (64).

Strengths and limitations

The findings we present are largely descriptive due to the exploratory nature of this method. Without a strong evidence base (of homogenous datasets) it would not have been appropriate to attempt to combine the data using quantitative methods. We found that there was also not sufficient evidence of effectiveness in the included studies to undertake ICA.

Our rationale for reviewing this heterogeneous group of complex interventions was to be able to learn from early stage research in this field, but we acknowledge that due to these limitations in the data we cannot reach definitive conclusions on what might comprise an effective intervention. Using our exploratory method, we have developed an elementary model broadly linking the intervention characteristics to outcomes. However, in terms of implications of our findings, we were unable to generate hypotheses about exactly how different intervention characteristics might influence different outcomes, as only partial data were available for each intervention characteristic and outcome.

It was not always possible to ascertain a complete picture of the intervention design process and some studies did not provide- details of challenges faced throughout the trial process. Further, it is likely that information about trial feasibility and uptake sometimes/often may not be published. In line with rapid review methodology, we recognise that the search was not comprehensive. Due to time constraints we did not include grey literature and we did not follow up with authors if we were unable to access papers.

A strength of our method is that we were able to integrate data from a variety of study designs at an early stage of development of the literature in this field. The identification of common themes across the variety of included studies suggests that it is possible to combine, and learn from, papers reporting different study designs, including qualitative reports and findings of early-stage interventions. The inclusion of both individual author and participant interpretations allowed us to go beyond intervention descriptions and explore real-world experiences of web-based interventions for cancer survivors (19). This approach can help to inform the development of interventions when there is limited definitive trial evidence available. An unexpected benefit of this review was that by combining data from a number of early studies it was possible to collate information about rare but potentially important risks of negative consequences for some users, which is particularly valuable for intervention design.

Individuals with particular characteristics (i.e. in a relationship, middle aged, Caucasian, and female) were overrepresented in most of the studies, limiting the ability to establish external validity (52). Developers must therefore be aware that it is unclear if specific subgroups would benefit from web-based interventions (specifically socioeconomically disadvantaged groups, low-health literacy groups, and ethnic minorities), which may impact the validity of any findings (65). Recruitment of heterogeneous samples and analysis of usage patterns to better contextualise findings is recommended.

Conclusions
The findings provide insights into factors that may influence the uptake, acceptability, feasibility, adherence, attrition, and positive behaviour change in web-based interventions for cancer survivors. Importantly, our analysis highlights specific issues for consideration when designing web-based interventions for those who have completed treatment for cancer. Cancer survivors appear to value interventions that recognise their changing needs and are delivered at the right stage of the cancer trajectory. The findings indicate that future work should initially concentrate on identifying the optimal stage of cancer survivorship to facilitate optimum intervention delivery.

We could not reach definitive conclusions about which factors are likely to lead to efficacious and effective interventions for this group, but as the area of research grows, future research can build on our findings by conducting comprehensive and systematic reviews.

We analysed data from a variety of study designs at an early stage of development to inform the emerging field of the literature about web-based interventions for survivors of prostate, colorectal and

breast cancer. The method of synthesising early stage research described in this paper may enable researchers to generate useful hypotheses about why interventions work or do not work as intended. This method may well have application in other areas, beyond cancer survivorship.

Clinical Implications.

It appears important to ensure that both the content and the timing of interventions is appropriate to the particular and varying support needs of cancer survivors. Participants in these studies appeared to have idiosyncratic motivations and abilities due to factors including side effects and disabilities, reprioritisation of goals after treatment, and concerns about the extent to which they could engage in behaviour change. The incorporation of specific behaviour change techniques into interventions for this group requires further exploration in order to enable us to better understand how interventions can be carefully designed to match users' capabilities, and avoid inadvertent negative consequences. User involvement in and feedback on the intervention during development may help to ensure that it is accessible, usable and appropriate.

Compliance with Ethical Standards:

Conflict of Interest:
Teresa Corbett declares that she has no conflict of interest. Karmpaul Singh declares that he has no conflict of interest. Liz Payne declares that she has no conflict of interest. Katherine Bradbury declares that she has no conflict of interest. Claire **Foster** declares that she has no conflict of interest. Eila Watson declares that she has no conflict of interest. Alison Richardson declares that she has no conflict of interest. Paul Little declares that he has no conflict of interest. Lucy Yardley declares that she has no conflict of interest.

Ethical approval:
 This article does not contain any studies with human participants or animals performed by any of the authors.

Table 1. *Inclusion and Exclusion Criteria of Studies in Review (Based on PICOS criteria)*		
	Inclusion criteria	*Exclusion criteria*
Participants	Adults who have completed primary treatment for breast, prostate and colorectal cancer (or interventions that included a variety of cancer types and focused on quality of life issues considered likely to be shared across all cancers).	• Specific target groups that were not generalizable to breast, colorectal or prostate cancer survivors (during primary treatment; pediatric samples, rare cancers, metastatic cancers etc.). • Studies where the focus was on needs associated with specific cancer types (e.g. a focus on specific needs associated with gynaecological/ head and neck cancers). • Interventions which took place during primary treatment
Interventions	Online, e-health or web-based interventions designed to improve QoL in adults who have completed primary treatment for cancer.	Interventions delivered offline or analyses of online forum groups and interventions delivered solely via social media websites (e.g. Facebook etc.);
Comparators	We did not include "Comparison" (C) as this is was not relevant to our research question(66).	
Outcomes	Quality of life and related outcomes (e.g. well-being and physical or mental health or functioning). Studies describing people's experiences, views, and perceptions of usability and/or acceptability data of interventions.	Studies that did not include data relating to actual intervention experience
Study Design	Studies considered included surveys, focus groups, individual interviews, and data from feasibility and pilot trials, RCTs, and process evaluations.	commentaries, audits, review articles not included

Table 2. *Quality Assessment of Included Studies*

Study Quality	ST* (34, 35)	WSDEI** (33)	STRIDE (44)	BREATH (42, 43)	HN*** (41)	PERC**** (47)	KNW***** (36, 37)	RESTORE (32, 38-40)	Oncowijzer (45, 46)
Methods, designs, and study conduct	++	++	++	++	-	++	-	++	+
Quality of data/effects achieved	++	++	+	+	+	++	+	+	+
Relevance	++	++	- -*	++	+	++	++	++	++
Overall study quality	++	++	+	++	-	++	+	++	+

Notes:	- - = very low	- = low	+ = medium	++ = high	*very specific population

ST*: Survive and Thrive

WSDEI**: Web-based self-management exercise and diet intervention program

HN***: Health Navigation

PERC****:Prostate Cancer Education and Resources for Couples

KNW*****: Kanker Nazorg Wijzer

Table 3. *Trial Details*

Trial name	Cancer type	Intervention target	Year	Country	Study type	N
Survive and Thrive (34, 35)	Breast, ovarian, uterine,	Encourage changes in health behaviours post-treatment	2015	USA	Randomized controlled trial.	352

Name	Cancer type	Aim	Year	Country	Study design	N
	non-Hodgkin's lymphoma, colorectal, lung, thyroid, oral.	(including: dieting, exercise, depression, and fatigue).			Exploratory analyses of engagement.	20
WSDEI (Health planner) (33)	Breast.	Promote positive dietary and exercise change post-treatment.	2014	South Korea	Pilot randomized controlled trial.	59
STRIDE (44)	Breast, prostate, non-Hodgkin's lymphoma.	Increase walking/physical activity.	2014	Australia	Qualitative pilot feasibility study.	8
BREATH (42, 43)	Breast.	Support psychological adjustment post- treatment; reduce stress and improve empowerment.	2015	Netherlands	Multi-centre randomized controlled trial.	150
					Sub-study analysis of usage.	70
Health Navigation (41)	Breast, colon, stomach, lung, uterine, thyroid.	Online tailored education program for managing/ reducing cancer related fatigue.	2012	South Korea	Randomized controlled trial.	273
PERC (47)	Prostate.	Online education and resources aimed to increase QoL for patients (e.g. symptom management etc.) and partners (increase communication etc.).	2015	USA	Mixed methods feasibility and acceptability pilot study.	26
Kanker Nazorg Wijzer (36, 37)	Unspecified (any cancer type accepted).	Improve self-management of lifestyle (e.g. physical activity, diet, and smoking), and psychosocial challenges post-treatment	2016	Netherlands	Randomized controlled trial.	432
RESTORE (32, 38-40)	Breast, colorectal, head/neck, liver, and prostate.	Reducing cancer-related fatigue, increasing self-efficacy.	2016	UK	Multi-centre proof of concept randomised controlled trial.	163
					Qualitative process evaluation.	19
Oncowijzer (45, 46)	Breast.	Provide information for survivors (various issues; physical, psychological, work/social etc.); and partners (e.g. relationships, care giving etc.).	2014	Belgium	Design and process evaluation.	134