

1 **Understanding acceptability of and engagement with web-based interventions aiming to**  
2 **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.

### Keywords

Cancer; survivorship; digital intervention; review; web-based; intervention development; oncology

## 1 **Background**

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

16 Previous reviews of interventions for cancer survivors have focused on questions of effectiveness,  
17 by reviewing controlled trials (10-12). However, much of the literature on web-based interventions  
18 for cancer survivors reports early stage research, consisting mainly of intervention development and  
19 feasibility studies. Systematic reviews are useful to synthesise research findings (13) but are most  
20 appropriate when a strong evidence base (of homogenous datasets) exists (14, 15). Reviews of  
21 heterogeneous, complex interventions frequently conclude that the evidence is ‘weak’ or ‘mixed’  
22 (12, 16) and often fail to address intervention usability and acceptability(13). It is important to  
23 understand how an intervention works in and suits a given context (15, 17). Integrating and  
24 implementing all currently available evidence on web-based interventions for cancer survivors,  
25 rather than simply definitive trials, could inform decisions regarding intervention design and  
26 delivery (17).

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

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

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

## 6 **Analysis**

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

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

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## 20 **Results**

### 21 *Characteristics of papers and interventions*

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

26 Three trials focused on multiple health behaviour changes; physical activity and diet. These were  
27 the *WSDEI (Health Planner)*(33), *Survive and Thrive* (34, 35)and *Kanker Nazorg Wijzer (KNW)*  
28 (36, 37) trials. Two trials (*RESTORE* (32, 38-40) and *Health Navigation*(41)) addressed fatigue in  
29 cancer survivors. *BREATH* (42, 43)and *STRIDE* (44)also specifically targeted particular outcomes  
30 (i.e. distress and physical activity). The *Oncowijzer* (45, 46) and *Prostate Cancer Education and*  
31 *Resources for Couples (PERC)* (47)studies focused on cancer survivors and their partners during  
32 the transition into survivorship (see Appendix B for full study descriptions).

### 33 Themes identified in this review

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

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

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

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

45

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

### 7 8 *Uptake*

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

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

### 22 *Adherence and attrition*

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

27 Higher attrition in the online intervention arms may have been due to participants struggling with  
28 the web-based nature of the trial (Au;Ps) (32, 33, 39, 45). Some authors suggested that accessing  
29 the intervention added burden and/ or required routine adjustments (Au; Ps) (32, 39, 45). However,  
30 some studies reported lower levels of attrition than average for online trials for cancer survivors  
31 (Q;Au) (33, 41, 47) (37). This was attributed to participants’ motivational readiness to engage (Au)  
32 (33, 41) and the relevance of the content (Au) (33, 37, 47). Other reasons suggested were  
33 convenience because participants were able to access the intervention at their own pace, when it  
34 suited them (Au) (33, 37, 41, 47) and the ease of use and accessibility of the content (Au) (33, 37,  
35 41, 47).

### 36 *Engagement*

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

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

1 physical and social consequences of cancer, returning to work, and communicating with others  
2 (Au;Ps;Q) (34, 35, 46). Other cited factors for engagement included computer literacy and socio-  
3 economic status. High usage rates in the *PERC* trial were deemed encouraging by study authors,  
4 particularly because the intervention targeted older adults (Au) (47). The exclusion of certain  
5 groups (e.g. limited computer literacy; elderly) was a concern for many authors (Au) (32, 33, 39,  
6 41, 45).

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

### 12 *Feasibility*

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

21 Web-based interventions were designed to be incorporated into participants' lives easily, yet some  
22 required additional work and/or routine adjustments for participants (Au) (33, 35, 36, 38, 41, 44,  
23 45, 47). This was particularly difficult when the participant had external burdens (e.g. competing  
24 demands such as family and work commitments, etc.) or were feeling unwell (e.g. experiencing  
25 pain or fatigue)(Au;Ps) (39, 44). Dealing with technical difficulties, and completing fatigue diaries  
26 were sometimes cited as burdensome by participants (Au;Ps;Q) (39, 44, 47).

### 27 *Efficacy*

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

### 31 *Satisfaction*

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

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

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

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

### 9 *Positive behaviour change*

10 Information provision was a commonly used strategy to promote behaviour change (Au) (32, 36,  
11 37, 45, 47). This included signposting to existing supplementary support resources and resources  
12 intended to facilitate follow-up conversations with healthcare professionals (Au; Ps) (32, 37, 43,  
13 47). Established national and international guidelines informed the content of many interventions  
14 (Au) (32, 33, 35, 37, 41, 44, 47). Other interventions were based on modified versions of pre-  
15 existing interventions (Au) (35-37).

16 Goal management prompted participants to prioritise activities, recognise limitations, and engage in  
17 self-reflection about lifestyle and behaviour and was widely regarded as motivating, (Au; Ps) (32,  
18 34, 36, 37, 39, 41, 44). *STRIDE* included step goal approach based on goal setting theory, which  
19 promoted goals that were perceived as attainable with respect to the individual's capacity. This  
20 reduced feelings of guilt on days participants felt unwell (Au; Ps) (44).

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

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

### 28 *Negative consequences for some users*

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



## 1 **Discussion**

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

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

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

28  
29 Our findings were largely consistent with non-cancer specific reviews that have suggested that  
30 efficacy of web-based interventions can vary due to factors including the timing of the interventions,  
31 targeting the wrong patients, or using an unsuitable mode of delivery (58, 59). However, our analysis  
32 identified specific issues that may be useful to consider when designing interventions for this group.  
33 For example, the studies reached inconsistent conclusions about whether content was more suitable to  
34 individuals with a current diagnosis or soon after treatment, or those at later stages of survivorship.  
35 This indicates that content may need to be tailored to stage-specific needs of those at different stages  
36 of the cancer trajectory. Further, it was unclear whether social networking features provide any added  
37 benefit. Web-based interventions are likely to function effectively without social networking  
38 components and with relatively little input from researchers or clinical staff (60).

39  
40 The findings of this review add to the literature on the use of behaviour change techniques such as  
41 self-monitoring of behaviour, planning, goal setting and review, and feedback on performance (61-63).  
42 In the interventions we assessed, self-monitoring and action planning seemed to be associated with  
43 positive behaviour change in many cases. However, these techniques occasionally proved difficult to  
44 incorporate into routines due to conflicting priorities after cancer, and even led to deleterious  
45 consequences in cases where participants failed to change behaviour. The selection of techniques to  
46 change behaviours should be appropriate to the characteristics of those participating in the trial, in  
47 order to avoid causing inadvertent harm (64).

## 48 ***Strengths and limitations***

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

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

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

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

28  
29 Individuals with particular characteristics (i.e. in a relationship, middle aged, Caucasian, and female)  
30 were overrepresented in most of the studies, limiting the ability to establish external validity (52).  
31 Developers must therefore be aware that it is unclear if specific subgroups would benefit from web-  
32 based interventions (specifically socioeconomically disadvantaged groups, low-health literacy groups,  
33 and ethnic minorities), which may impact the validity of any findings (65). Recruitment of  
34 heterogeneous samples and analysis of usage patterns to better contextualise findings is recommended.

### 35 ***Conclusions***

36  
37 The findings provide insights into factors that may influence the uptake, acceptability, feasibility,  
38 adherence, attrition, and positive behaviour change in web-based interventions for cancer survivors.  
39 Importantly, our analysis highlights specific issues for consideration when designing web-based  
40 interventions for those who have completed treatment for cancer. Cancer survivors appear to value  
41 interventions that recognise their changing needs and are delivered at the right stage of the cancer  
42 trajectory. The findings indicate that future work should initially concentrate on identifying the  
43 optimal stage of cancer survivorship to facilitate optimum intervention delivery.

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

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

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

#### 4 ***Clinical Implications.***

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

14  
15 Compliance with Ethical Standards:

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#### 19 **Conflict of Interest:**

20 Teresa Corbett declares that she has no conflict of interest. Karpaul Singh declares that he has no  
21 conflict of interest. Liz Payne declares that she has no conflict of interest. Katherine Bradbury declares  
22 that she has no conflict of interest. Claire **Foster** declares that she has no conflict of interest. Eila  
23 Watson declares that she has no conflict of interest. Alison Richardson declares that she has no  
24 conflict of interest. Paul Little declares that he has no conflict of interest. Lucy Yardley declares that  
25 she has no conflict of interest.

#### 26 27 **Ethical approval:**

28 This article does not contain any studies with human participants or animals performed by any of the  
29 authors.

<i>Table 1. Inclusion and Exclusion Criteria of Studies in Review (Based on PICOS criteria)</i>		
	<i>Inclusion criteria</i>	<i>Exclusion criteria</i>
<i>Participants</i>	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).	<ul style="list-style-type: none"> <li>• Specific target groups that were not generalizable to breast, colorectal or prostate cancer survivors (during primary treatment; pediatric samples, rare cancers, metastatic cancers etc.).</li> <li>• 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).</li> <li>• Interventions which took place during primary treatment</li> </ul>
<i>Interventions</i>	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.);
<i>Comparators</i>	We did not include “Comparison” (C) as this is was not relevant to our research question(66).	
<i>Outcomes</i>	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
<i>Study Design</i>	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	<i>ST</i> * (34, 35)	<i>WSDEI</i> * (33)	<i>STRIDE</i> (44)	<i>BREATH</i> (42, 43)	<i>HN</i> *** (41)	<i>PERC</i> **** (47)	<i>KNW</i> ***** (36, 37)	<i>RESTORE</i> (32, 38-40)	<i>Oncowijzer</i> (45, 46)
Methods, designs, and study conduct	++	++	++	++	-	++	-	++	+
Quality of data/effects achieved	++	++	+	+	+	++	+	+	+
Relevance	++	++	--*	++	+	++	++	++	++
<i>Overall study quality</i>	++	++	+	++	-	++	+	++	+

**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*

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

	non-Hodgkin's lymphoma, colorectal, lung, thyroid, oral.	(including: dieting, exercise, depression, and fatigue).			Exploratory analyses of engagement.	20
<b>WSDEI (Health planner) (33)</b>	Breast.	Promote positive dietary and exercise change post-treatment.	2014	South Korea	Pilot randomized controlled trial.	59
<b>STRIDE (44)</b>	Breast, prostate, non-Hodgkin's lymphoma.	Increase walking/physical activity.	2014	Australia	Qualitative pilot feasibility study.	8
<b>BREATH (42, 43)</b>	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
<b>Health Navigation (41)</b>	Breast, colon, stomach, lung, uterine, thyroid.	Online tailored education program for managing/ reducing cancer related fatigue.	2012	South Korea	Randomized controlled trial.	273
<b>PERC (47)</b>	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
<b>Kanker Nazorg Wijzer (36, 37)</b>	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
<b>RESTORE (32, 38-40)</b>	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
<b>Oncowijzer (45, 46)</b>	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