UCLA
UCLA Previously Published Works

Title

Survivorship care in breast cancer: understanding implementation barriers through the lens of the Theoretical Domains Framework

Permalink

https://escholarship.org/uc/item/97x9j94q

Journal

JNCI Cancer Spectrum, 8(1)

ISSN

2515-5091

Authors

Brauer, Eden R

Petersen, Laura

Ganz, Patricia A

Publication Date

2024-01-04

DOI

10.1093/jncics/pkad108

Peer reviewed

OXFORD

Survivorship care in breast cancer: understanding implementation barriers through the lens of the Theoretical Domains Framework

Eden R. Brauer [ID], PhD, RN,[1,2,*] Laura Petersen [ID], MS,[2] Patricia A. Ganz, MD[2,3,4]

[1]School of Nursing, University of California Los Angeles, Los Angeles, CA, USA
[2]Center for Cancer Prevention and Control Research, Jonsson Comprehensive Cancer Center, University of California Los Angeles, Los Angeles, CA, USA
[3]Division of Hematology-Oncology, Department of Medicine, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA
[4]Department of Health Policy and Management, Fielding School of Public Health, University of California Los Angeles, Los Angeles, CA, USA

*Correspondence to: Eden R. Brauer, PhD, RN, School of Nursing, University of California Los Angeles, 700 Tiverton Dr, Rm 4-234, Los Angeles, CA, USA 90095 (e-mail: erbrauer@mednet.ucla.edu).

Abstract

Background: Breast cancer survivorship guidelines with specific recommendations on managing long-term effects are available, but uptake in clinical practice remains low. Using the lens of the Theoretical Domains Framework, we aimed to understand key factors in guideline-concordant management of long-term effects to inform future implementation efforts in clinical practice contexts.

Methods: As part of a broader survey of oncologists, a theory-guided questionnaire was developed. Oncologists were asked to report level of agreement with Theoretical Domains Framework–based statements, current usage and perceived value of survivorship resources, and frequency of managing long-term effects in routine care. Data analyses included psychometric assessment of the questionnaire, descriptive summaries of theoretical domains and survivorship resources, and multivariable logistic regression models.

Results: In total, 217 oncologists completed the Theoretical Domains Framework–based questionnaire; 54% of oncologists reported "always or almost always" evaluating physical effects at routine survivorship appointments, while 34% did so for psychosocial effects. In regression models, Environmental Context and Resources was the only theoretical domain found to be statistically significantly associated with "always or almost always" evaluating both physical (odds ratio = 0.29, 95% confidence interval = 0.09 to 0.80) and psychosocial (odds ratio = 0.09, 95% confidence interval = 0.02 to 0.35) effects.

Conclusions: Findings support application of the Theoretical Domains Framework in understanding oncologists' behaviors and perceived barriers in managing long-term effects in breast cancer survivors. In future implementation efforts, this theory-informed approach can be used to target relevant domains and strategies focused on embedding guideline recommendations in the clinical context through structured resources and environmental supports.

Across all types and stages, the 5-year relative survival for breast cancer is 91% in the United States (1). The majority of new cases occur in women with localized disease at diagnosis (63%), which is associated with a 99% 5-year survival rate (2). By 2030, the number of breast cancer survivors is projected to reach 5 million, representing 23% of total cancer survivors (3,4). As the number of long-term breast cancer survivors continues to increase, clinical management of chronic treatment, disease-related effects, and cancer-related functional impairments has become a high priority (5,6).

Many survivorship guidelines are available to help clinicians provide high-quality survivorship care to this population, including guidelines from the National Comprehensive Cancer Network and disease-specific survivorship guidelines developed jointly by the American Cancer Society and American Society of Clinical Oncology (7,8). These guidelines provide a framework for comprehensive survivorship care, including surveillance for recurrence, screening for subsequent primary cancers, assessment and management of physical and psychosocial long-term and late effects, health promotion, and care coordination, with specific recommendations for the cancer type and patient population. Effective evidence-based strategies to manage common chronic issues in breast cancer survivors, such as peripheral neuropathy, lymphedema, pain, cognitive impairment, and menopausal symptoms, are described in detail.

Despite these efforts, guideline-informed delivery of survivorship care in routine clinical practice has been limited. Known challenges in survivorship care delivery include the wide variation in models of care (9), lack of training among both oncology and primary care clinicians to address chronic effects (10), underuse of multidisciplinary team–based approaches (11), and financial barriers (12,13). Incorporating the unique aspects of specific cancer types and treatments adds to the complexity in routine care. As a result, many breast cancer survivors do not receive recommended support for common long-term effects (11,14,15). Collectively, these gaps underscore a need for

implementation science approaches to facilitate the translation of solid evidence into clinical delivery of survivorship care (16,17).

To better understand implementation uptake barriers in guideline-concordant survivorship care for breast cancer, with specific attention on the management of long-term effects, we applied the Theoretical Domains Framework (18,19). In implementation science, the application of theories and conceptual frameworks is recommended to provide an organizing structure for analyzing the interplay between individuals and their environment and the influence of those interactions on specific patterns of behaviors (20,21). Comprising 14 theoretical domains, the Theoretical Domains Framework is considered a determinant framework because it facilitates a systematic overview of influences on a desired implementation outcome (21-23). In addition, the Theoretical Domains Framework has been widely used in understanding challenges related to implementing clinical guidelines and evidence-based recommendations in health-care settings (24,25). By assessing determinants through the lens of the Theoretical Domains Framework, specific evidence-based strategies can be selected to address known barriers, employ potential facilitators, and ultimately increase the likelihood of successful implementation of a clinical guideline (26-28). In addition, it is often not feasible or necessary to address all determinants; therefore, a theory-based assessment can help pinpoint high-impact targets (22).

In this project, we first conducted a Theoretical Domains Framework–guided qualitative study to investigate barriers and facilitators to guideline-concordant survivorship care through in-depth interviews with medical oncologists and focus groups with breast cancer survivors (29). Based on these findings, we then developed and administered a survey to a national sample of medical oncologists focused on current practice patterns and guideline-concordant survivorship care. Key findings from this survey have been previously reported and revealed major gaps in specific recommendations, such as the provision of survivorship care plans, assessment of psychosocial adverse effects, and screening for subsequent cancers (30).

As 1 component of the survey, we conducted a theory-based assessment of influences on a particular implementation behavior of interest: oncologists' management of long-term effects in breast cancer survivors according to clinical guidelines. In this article, we present the development and psychometric assessment of the Theoretical Domains Framework–guided questionnaire and the results from the survey to determine key influences on management of long-term effects in breast cancer survivors. We then identify potential strategies that can be used to improve future implementation efforts in guideline-concordant breast cancer survivorship care using a tailored approach.

Methods
Development of Theoretical Domains Framework–guided survey component

The Medical Oncologist Survivorship Survey study used a sequential exploratory mixed-methods design in which a quantitative survey was developed and fielded following a prior qualitative investigation (31,32). The Theoretical Domains Framework–guided component of the survey was directly informed by the findings of the prior qualitative investigation, in which we identified 9 theoretical domains that were salient in the context of survivorship care (29). Table 1 presents the refined framework,

domains, definitions, associated constructs, and adaptations for this project. Our qualitative findings also indicated that some domains hung together in clusters, which we used as a basis to further collapse domains for this project, as in other Theoretical Domains Framework studies (33). For example, Emotion was merged with Beliefs About Consequences as patients' sense of being emotionally overwhelmed was an important consequence that oncologists considered when discussing potential long-term effects. Knowledge and Skills were included as 1 domain because of conceptual overlap. Social Influences was combined with Optimism and renamed *Patient Influences* to represent oncologists' desire to preserve hope for their patients (Figure 1).

To develop specific items in the Theoretical Domains Framework–based component, we primarily adapted items from an existing, generic Theoretical Domains Framework questionnaire designed for this purpose, with acceptable construct validity and internal consistency (34,35). Using the "TACTA" approach described by Atkins and colleagues, we adapted generic Theoretical Domains Framework–based statements representing specific domains by inserting time (T), action (A), context (C), and target (Ta) details of the problem under investigation (24). For example, we modified the generic Environmental Context and Resources statement, "In the organization I work, [A] in [C, T] with [Ta] is routine," with "In the clinical practice where I work, [assessing and managing long-term effects] in [post-treatment appointments] with [breast cancer survivors] is routine." For some domains, new items were developed based on the qualitative interviews. Consistent with other Theoretical Domains Framework–based questionnaire studies (36-38), individual items represented Theoretical Domains Framework–based statements with 5-point Likert scale response options, ranging from 1 ("strongly agree) to 5 ("strongly disagree"). Positive and negative phrasing was employed to reduce the threat of acquiescence bias.

In addition to the Theoretical Domains Framework items, this survey section collected information about oncologist behaviors related to managing long-term effects in routine care. From a Theoretical Domains Framework perspective, outcome variables represent the target behavior, which is potentially influenced by the various theoretical domains under investigation. This study examined 2 outcome variables: oncologist-reported frequency of evaluating 1) physical and 2) psychosocial long-term effects in survivorship appointments with breast cancer survivors. Response options for the outcome variables used a 5-point scale, from "always or almost always" to "rarely or never." Target outcomes related to physical vs psychosocial effects were measured separately because we hypothesized that barriers and facilitators may differ across these behaviors.

The remaining items of this section explored the Environmental Context and Resources domain, which was identified as highly salient in the qualitative findings. To delve further into this domain, participants were asked to report current use and perceived value across 17 potential survivorship resources, which were pooled from qualitative data, clinical experiences, and current literature. Response options for each resource were 1) "I use it and it's helpful"; 2) "I don't use it but I think it would be helpful"; 3) "I use it and it's not helpful"; and 4) "I don't use it, and I don't think it would be helpful." Before administration, the complete survey was pilot-tested by a sample of 6 intended respondents to ensure relevance, comprehensiveness, and comprehensibility.

Table 1. Theoretical Domains Framework domains, definitions, and constructs in the context of breast cancer survivorship care among oncologists (34)

Domain	Definition	Constructs	Adaptation to project
Knowledge	An awareness of the existence of something	Knowledge Procedural knowledge Knowledge of task environment	Do oncologists know how to assess and manage long-term and late treatment effects in breast cancer survivors?
Skills	An ability or proficiency acquired through practice	Skills Skills development Competence Ability Interpersonal skills Practice Skill assessment	Do oncologists feel able and have the correct training to assess and manage long-term and late effects in breast cancer survivors?
Beliefs About Capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use	Self-confidence Perceived competence Self-efficacy Perceived behavioral control Beliefs Self-esteem Empowerment Professional confidence	Do oncologists feel capable, confident, and comfortable to assess and manage long-term and long effects in breast cancer survivors?
Social Influences	Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviors	Social pressure Social norms Group conformity Social comparisons Group norms Social support Power Intergroup conflict Alienation Group identity	Do other individuals (adapted as "patients") influence whether oncologists assess and manage long-term and late effects in breast cancer survivors?
Optimism	The confidence that things will happen for the best or that desired goals will be attained	Optimism Pessimism Unrealistic optimism Identity	Do oncologists feel optimistic and hopeful in assessing and managing long-term and late effects in breast cancer survivors?
Beliefs About Consequences	Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation	Beliefs Outcome expectancies Characteristics of outcome expectancies Anticipated regret Consequents	What do oncologists think will be the result if they assess and manage long-term and late effects in breast cancer survivors?
Emotion	A complex reaction pattern involving experiential, behavioral, and physiological elements by which the individual attempts to deal with a personally significant matter or event	Fear Anxiety Affect Stress Depression Positive/negative affect Burn-out	Do emotions/feelings influence whether oncologists assess and manage long-term and late effects in breast cancer survivors?
Social/Professional Role and Identity	A coherent set of behaviors and displayed personal qualities of an individual in a social or work setting	Professional identity Professional role Social identity Identity Professional boundaries Professional confidence Group identity Leadership Organizational commitment	Do oncologists feel that assessing and managing long-term and late effects in breast cancer survivors are part of their professional responsibility?
Environmental Context and Resources	Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior	Environmental stressors Resources or material resources Organizational culture or climate Salient events or critical incidents Person × environment interaction Barriers and facilitators	Do oncologists have adequate resources to assess and manage long-term and late effects in breast cancer survivors?

Data collection

The survey was administered between October 2018 and April 2020. Potentially eligible individuals were identified using a large commercial database and an internal list of a major professional society and invited to participate (30). Individuals who opted to participate were sent a unique survey link and entered response
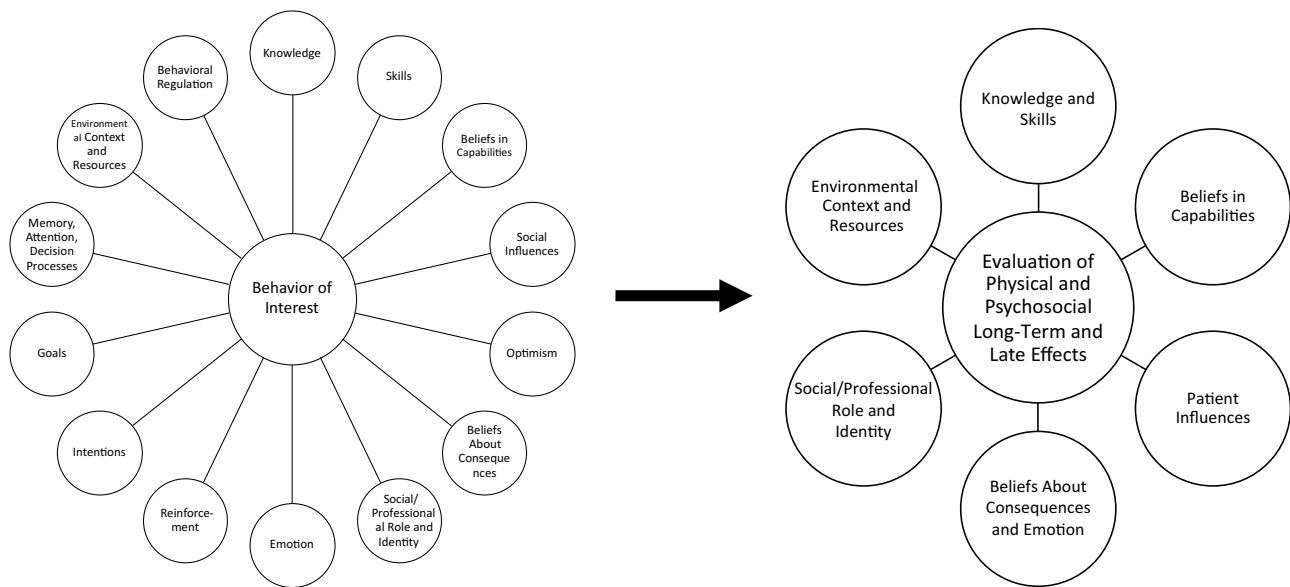
Figure 1. Adaptation of the Theoretical Domains Framework (18,27)

data directly into a secure, web-based software platform, Research Electronic Data Capture (39,40). The Institutional Review Board approved this study, and participants received a $50 gift card for their time.

Data analyses

A confirmatory factor analysis was conducted to test the modified Theoretical Domains Framework and assess the initial construct validity of the questionnaire. Each questionnaire item loaded onto 1 domain only, and all loadings were standardized using a weighted least square estimates robust estimator to test the 6-factor model (41-44). The model was assessed for goodness of fit and revised iteratively to produce a model that was both theoretically meaningful and statistically acceptable. Items were removed systematically if the loading was not statistically significant ($P > .05$) or considered low ($P > .5$) (45,46) but retained in spite of these conditions to ensure a minimum of 3 items per factor (35,47). Exact fit was assessed using the χ^2 test (42), and the following guidelines were applied to assess approximate fit: comparative fit index of 0.90 or higher (48) and root mean square error of approximation less than 0.05 to indicate close approximate fit (41,45,46,49). Internal consistency was assessed by calculating Cronbach α for each domain before and after the confirmatory factor analysis. Because this research was exploratory, an α value between .60 and .95 was considered acceptable (50,51). Discriminant validity was assessed using the Fornell and Larcker criterion test (52).

Data from all completed questionnaires were analyzed, and missing values were omitted. Descriptive summaries of theoretical domains, including means and SDs, were analyzed. With a possible range of 1 to 5, lower scores were interpreted as facilitators and higher scores as barriers to the target outcomes (53). Frequencies of the target behaviors were calculated, and the association between the 2 variables was measured using χ^2 tests. Data regarding oncologists' current use and perceived value of survivorship resources were analyzed as proportions for descriptive comparisons. Multivariable logistic regression analyses were performed to investigate associations between theoretical domains and the likelihood of "always or almost always"

performing the 2 target behaviors, controlling for practice (region, type) and oncologist factors (age, gender). Statistical analyses were performed in RStudio (Posit Software, Boston, MA) using the *lavaan* library for the confirmatory factor analysis; statistical significance was set at P equal to .05 (54).

Results

Psychometric assessment of Theoretical Domains Framework–based questionnaire

The initial confirmatory factor analysis showed poor model fit (χ^2 (284) = 448.7, $P < .001$; $df = 1.58$; comparative fix index = 0.73 and root mean square error of approximation = 0.06). In post hoc fitting, 7 items were removed, resulting in a final 19-item questionnaire, which represented Knowledge and Skills (3 items), Beliefs About Capabilities (3 items), Patient Influences (3 items), Beliefs About Consequences (4 items), Social/Professional Role and Identity (3 items), and Environmental Context and Resources (3 items) (Supplementary Table 1, available online). Confirmatory factor analysis results of the revised 6-factor model demonstrated approximate fit to the data, χ^2 (137) = 174.9, $P = .016$. The χ^2 statistic to df ratio (1.277) was acceptable, and the approximate goodness-of-fit indices indicated close approximate fit (comparative fix index = 0.92 and root mean square error of approximation = 0.04). Post–confirmatory factor analysis Cronbach α for domains are presented in Table 2. All domains in the final model were found to display discriminant validity according to the Fornell and Larcker test, suggesting that these domains measure distinct constructs, with the exception of Environmental Context and Resources.

Results of Theoretical Domains Framework–based questionnaire in the sample of oncologists

During the study period, 2399 study invitations were mailed and 429 individuals (17.9%) responded. Of these, 244 were deemed eligible and 217 completed the questionnaire. On average (SD), respondents were 45.9 (12.8) years of age, with 13% reporting receipt of training in survivorship care. Approximately half of oncologists were male (49%), non-Hispanic White (48%), and

Table 2. Theoretical domain summary scores[a]

Theoretical domains	Mean	SD	Scale reliability, α
Environmental Context and Resources	1.63	0.48	.39
Beliefs About Capabilities	1.66	0.62	.78
Beliefs About Consequences	1.69	0.51	.70
Patient Influences	1.72	0.5	.61
Social/Professional Role and Identity	1.76	0.62	.59
Knowledge and Skills	1.89	0.69	.68

[a] Mean summary scores for each theoretical domain can range from 1 to 5, with lower scores indicating facilitators and higher scores indicating barriers to target outcomes.

practiced in academic settings (50%). The sample was geographically dispersed across the United States, with the largest proportion in the Northeast (25.8%). Further details about the sample are presented elsewhere (30).

Mean (SD) values of the theoretical domain summary scores ranged from 1.63 (0.48) for Environmental Context and Resources to 1.89 (0.69) for Knowledge and Skills (Table 2). For the 2 outcomes, 54% of oncologists reported "always or almost always" evaluating physical long-term effects, such as pain, lymphedema, and peripheral neuropathy, at post-treatment appointments, while 34% of participants reported doing so for psychosocial effects, such as depression, anxiety, and fear of recurrence. The χ^2 tests indicated a moderate association between the 2 target outcomes (Cramer $V = 0.648$), representing the extent of overlap between oncologists who reported evaluating physical effects vs psychosocial effects.

Multivariable logistic regressions were performed to identify theoretical domains that were associated with "always or almost always" evaluating physical effects in 1 model and psychosocial effects in a separate model, controlling for practice (geographic region, practice type) and oncologist (age, gender) factors (Tables 3 and 4). In both models, the domain Environmental Context and Resources was statistically significantly associated with the target behavior. A 1-point increase in the Environmental Context and Resources score increased the odds of an oncologist "always or almost always" evaluating physical long-term effects 3.49 times ($P = .021$) and "always or almost always" evaluating psychosocial long-term effects 11.09 times ($P < .001$), respectively. Statistically significant associations between other theoretical domains and the 2 target variables were not observed.

Oncologist-reported current use and perceived value of various survivorship resources are presented in Figure 2. The highest current use rates were reported for chemotherapy classes (80.5%), patient portal communication (79.2%), and educational handouts from national sources (75.9%), while the lowest usage rates were reported for structured communication aids or scripts (42%), remote symptom monitoring (39%), and educational videos (27%). The high use and high perceived value category included chemotherapy classes (76%), patient portal communication (72%), educational handouts (72%), and support groups (70%). Of all resources assessed, a psycho-oncology referral was perceived as being the most helpful.

Resources with low use and high perceived value included standardized checklists for assessing long-term and late effects (currently used by 25%, perceived as valuable by 90%), patient-reported outcomes of post-treatment symptoms (currently used by 36%, perceived as valuable by 78%), structured communication aids or scripts (currently used by 22%, perceived as valuable by 81%), educational videos (currently used by 14%, perceived as

valuable by 80%), and remote symptom monitoring (currently used by 21%, perceived as valuable by 88%).

Discussion

Despite efforts to develop survivorship guidelines, our study suggests that many barriers exist to these recommendations reaching patients and clinical care settings as intended. Surveillance of a wide range of potential physical and psychosocial long-term sequelae in growing populations of breast cancer survivors over extended periods of time presents a clinical challenge. Current clinical approaches have resulted in wide variations in care and under-recognition of chronic issues in survivors. Although long-term effects are common among breast cancer survivors and negatively affect quality of life, findings from this study demonstrate that they are not assessed routinely at survivorship appointments, revealing important missed opportunities to identify and manage these issues effectively. This trend is particularly pronounced for evaluation of adverse psychosocial effects.

Using an implementation science approach helped identify key influences on the implementation problem of managing long-term effects in breast cancer survivorship care and home in on factors that can be used in future implementation efforts (26,27). The theoretical determinants identified in this assessment deepen our understanding of the target behavior but can also inform next steps through linkages with potential implementation strategies using structured taxonomies, such as the Capability, Opportunity, Motivation, Behavior Model of the Behavior Change Wheel (19,26,28,55) or the Expert Recommendations for Implementing Change compilation (56,57). For example, the strong influence of Environmental Context and Resources on both target outcomes can be mapped to specific intervention functions and behavior change techniques in the Behavior Change Wheel, such as environmental restructuring or enablement, which focus on modifying individuals' opportunities and automatic motivation to perform a target behavior through environmental and contextual strategies (26). Although Theoretical Domains Framework–based assessments often provide descriptive overviews of determinants without granular details, the current study highlighted actionable opportunities based on oncologists' perspectives on specific survivorship resources. Used in conjunction with implementation strategies, these findings provide a structured, theory-informed approach to shape the clinical context of care delivery and enhance precision in the implementation process (26,27).

To facilitate the translation of clinical guidelines into practice using environmental and contextual strategies, informatics-based approaches are likely needed. Simply offering clinicians more resources will likely be insufficient to improving implementation, particularly in community settings, where clinicians may care for survivors with heterogenous cancer diagnoses and wide-ranging survivorship concerns. Instead, our findings suggest that we focus on embedding guideline recommendations within the architecture and workflow of electronic health record systems using potentially high-impact resources. Respondents in this study expressed strong interest in the integration of brief electronic patient-reported checklist-type measures to efficiently identify the risk or presence of common long-term effects and post-treatment concerns. Remote monitoring and telehealth support may enhance feasibility in certain settings and enable survivors to report issues to their care team once the frequency of their appointments has decreased. Likewise, the use of clinical decision support, such as prompts and cues that function as

Table 3. Theoretical domains associated with "always or almost always" evaluating physical effects in breast cancer survivors at routine survivorship appointments[a]

Theoretical domain	Odds ratio	95% Confidence interval		P
		Lower	Upper	
Intercept	147.08	8.35	3402.42	.001
Knowledge and Skills	1.18	0.63	2.22	.611
Beliefs About Capabilities	0.72	0.32	1.61	.418
Patient Influences	0.87	0.39	1.90	.723
Beliefs About Consequences	0.53	0.23	1.22	.139
Social/Professional Role and Identity	1.12	0.54	2.35	.755
Environmental Context and Resources	0.29	0.09	0.80	.021

[a] Models were adjusted for the following covariates: geographic region of practice, practice type, oncologist age, and oncologist gender.

Table 4. Theoretical domains associated with "always or almost always" evaluating psychosocial effects in breast cancer survivors at routine survivorship appointments[a]

Theoretical domain	Odds ratio	95% Confidence interval		P
		Lower	Upper	
Intercept	5181.32	126.34	366422.0	<.001
Knowledge and Skills	0.98	0.48	2.01	.962
Beliefs About Capabilities	0.81	0.31	2.16	.673
Patient Influences	1.28	0.49	3.37	.614
Beliefs About Consequences	0.67	0.26	1.75	.417
Social/Professional Role and Identity	0.59	0.24	1.40	.237
Environmental Context and Resources	0.09	0.02	0.35	<.001

[a] Models were adjusted for the following covariates: geographic region of practice, practice type, oncologist age, and oncologist gender.

behavioral nudges, in conjunction with patient-reported assessment data may restructure the environment by offering actionable recommendations to clinicians in routine workflow (58,59). Brief patient education videos with information about common long-term effects, self-management strategies, and when to seek higher-level care can also be delivered through secure patient portals as part of an individualized survivorship plan of care. To promote widespread uptake, such resources should be made publicly available and fully compatible with major electronic health record systems. Adopting standardized patient-reported measures related to survivorship needs and quality-of-care metrics will not only help clinicians identify and address issues more effectively at the patient level but also provide a rapid learning system in which real-time data can be used to improve care delivery and patient outcomes across clinical contexts (60-62). Over time, such tools have the potential to generate information regarding the effectiveness of survivorship interventions, optimization of resource allocation, risk stratification of patients based on survivorship needs, and overall refinement of the approach to care delivery (63).

This study is novel in its theoretical approach to understanding barriers and facilitators to guideline-concordant management of long-term effects in survivorship care, but limitations should be addressed. The breadth of the Theoretical Domains Framework poses challenges for a physician survey for which recruitment has become increasingly difficult (64,65). There is a need to balance the scope of the Theoretical Domains Framework and the length of a questionnaire that adequately measures the domains with parsimony and minimal survey burden. Results may not be representative of the larger population because of the relatively small sample size and selection biases in recruitment. Although the selection of domains in the final questionnaire was grounded in previous study results and this is an acceptable adaptation in Theoretical Domains Framework research, withdrawn domains may be relevant to the outcomes
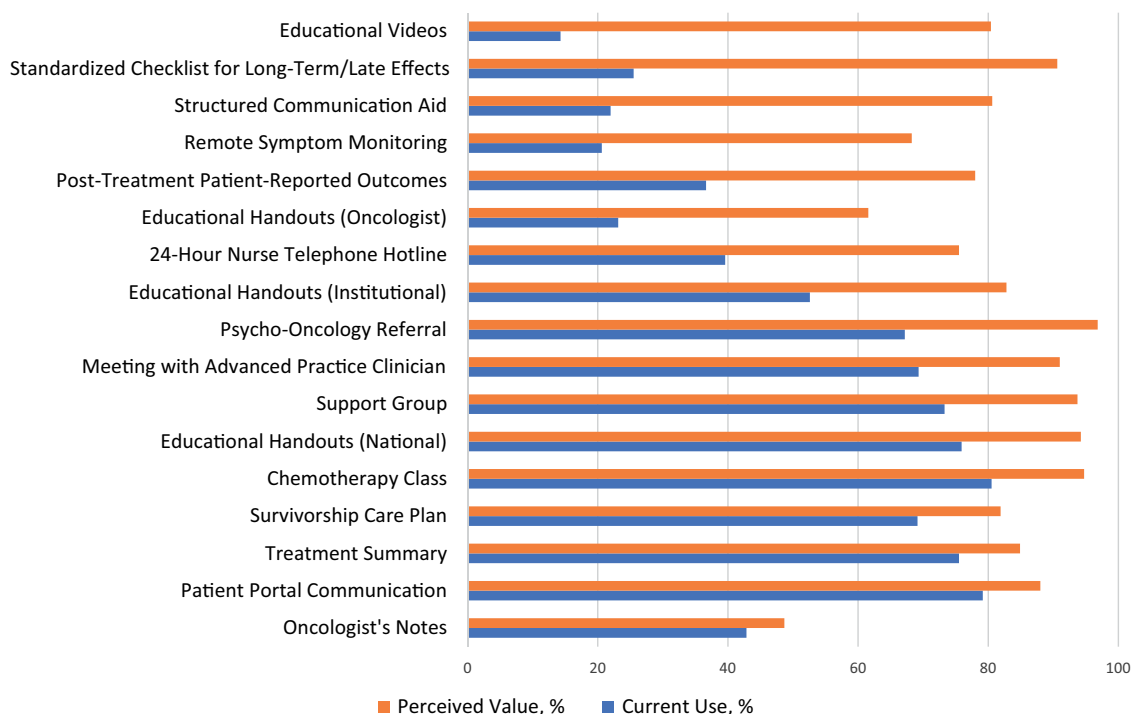
Figure 2. Current use and perceived value of potential environmental resources

of interest, resulting in decreased validity. In addition, the low variation in summary scores across theoretical domains made it difficult to determine relative importance to implementation outcomes of interest. With multiple survivorship care guidelines available, it is possible that respondents may not have been referring to the American Cancer Society and American Society of Clinical Oncology guidelines used to develop the questionnaire. Finally, the domain Environmental Resources and Context did not demonstrate adequate reliability or discriminant validity but was retained in the models because of its compelling influence on the outcomes of interest. Future work should aim to clarify boundaries between theoretical domains and improve the psychometric performance of the questionnaire.

Despite these limitations, this study provides a basis for understanding implementation challenges in survivorship care for breast cancer, an area with substantial evidence and resources compared to other cancer types, and provides concrete directions for next steps. The theory-grounded approach in this study may be useful in improving a particularly challenging aspect of survivorship care: assessment and management of a broad range of long-term effects for a growing number of long-term breast cancer survivors. Given the strong influence of environmental determinants, informatics-based approaches may be more feasible and impactful in transforming clinical contexts of care and supporting successful and sustainable integration of survivorship guidelines in clinical practice.

Data availability

The data that support the findings of this study are available on reasonable request from the corresponding author, E.R.B.

Author contributions

Eden R. Brauer, PhD, RN (Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Visualization; Writing – original draft; Writing – review & editing), Laura Petersen, MS (Data curation; Formal analysis; Methodology; Project administration; Resources; Software), Patricia Ganz, MD (Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Writing – original draft; Writing – review & editing).

Funding

Conflicts of interest

Eden R. Brauer—no disclosures.

Laura Petersen—no disclosures.

Patricia A. Ganz—no relevant disclosures with the exception that Dr Ganz also serves as a member of the Breast Cancer Research Foundation scientific advisory board.

Acknowledgements

References

1. Siegel RL, Miller KD, Wagle NS, et al. Cancer statistics, 2023. *CA Cancer J Clin.* 2023;73(1):17-48. doi:10.3322/CAAC.21763.

2. National Cancer Institute Surveillance, Epidemiology, and End Results Program. *Female Breast Cancer–Cancer Stat Facts.* https://seer.cancer.gov/statfacts/html/breast.html. Accessed November 23, 2023.

3. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2021. *CA Cancer J Clin.* 2021;71(1):7-33. doi:10.3322/caac.21654

4. Miller KD, Nogueira L, Devasia T, et al. Cancer treatment and survivorship statistics, 2022. *CA Cancer J Clin.* 2022;72(5):409-436. doi:10.3322/CAAC.21731.

5. Emery J, Butow P, Lai-Kwon J, Nekhlyudov L, Rynderman M, Jefford M. Management of common clinical problems experienced by survivors of cancer. *Lancet.* 2022;399(10334):1537-1550. doi:10.1016/S0140-6736(22)00242-2.

6. Moore HCF. Breast cancer survivorship. *Semin Oncol.* 2020;47(4):222-228. doi:10.1053/j.seminoncol.2020.05.004.

7. Runowicz CD, Leach CR, Henry NL, et al. American Cancer Society/American society of clinical oncology breast cancer survivorship care guideline. *CA Cancer J Clinicians.* 2016;66(1):43-73. doi:10.3322/caac.21319

8. Sanft T, Day A, Ansbaugh S, et al. NCCN guidelines® insights: survivorship, version 1.2023: featured updates to the NCCN guidelines. *J Natl Compr Cancer Netw.* 2023;21(8):792-803. doi:10.6004/JNCCN.2023.0041.

9. Jefford M, Howell D, Li Q, et al. Improved models of care for cancer survivors. *Lancet.* 2022;399(10334):1551-1560. doi:10.1016/S0140-6736(22)00306-3.

10. Lisy K, Kent J, Piper A, Jefford M. Facilitators and barriers to shared primary and specialist cancer care: a systematic review. *Support Care Cancer.* 2021;29(1):85-96. doi:10.1007/s00520-020-05624-5.

11. Vuksanovic D, Sanmugarajah J, Lunn D, Sawhney R, Eu K, Liang R. Unmet needs in breast cancer survivors are common, and multidisciplinary care is underutilised: the Survivorship Needs Assessment Project. *Breast Cancer.* 2021;28(2):289-297. doi:10.1007/S12282-020-01156-2/FIGURES/2.

12. Blaes AH, Abu-Khalaf MM, Bender CM, et al. Identifying gaps in the coverage of survivorship care services. *JCO.* 2021;39(15):6583-6583. doi:10.1200/JCO.2021.39.15_suppl.6583

13. Halpern MT, McCabe MS, Burg MA. The cancer survivorship journey: models of care, disparities, barriers, and future directions. *Am Soc Clin Oncol Educ Book.* 2016;35(36):231-239. doi:10.1200/edbk_156039.

14. Martínez Arroyo O, Andreu Vaíllo Y, Martínez López P, Galdón Garrido MJ. Emotional distress and unmet supportive care needs in survivors of breast cancer beyond the end of primary treatment. *Support Care Cancer.* 2019;27(3):1049-1057. doi:10.1007/s00520-018-4394-8.

15. Ganz PA, Hahn EE, Petersen L, et al. Quality of posttreatment care among breast cancer survivors in the University of California Athena Breast Health Network (Athena). *Clin Breast Cancer.* 2016;16(5):356-363. doi:10.1016/j.clbc.2016.05.003.

16. Gallicchio L, Tonorezos E, de Moor JS, et al. Evidence gaps in cancer survivorship care: a report from the 2019 national cancer institute cancer survivorship workshop. *J Natl Cancer Inst.* 2021;113(9):1136-1142. doi:10.1093/JNCI/DJAB049.

17. Norton WE, Kennedy AE, Mittman BS, et al. Advancing rapid cycle research in cancer care delivery: a National Cancer Institute workshop report. *J Natl Cancer Inst.* 2023;115(5): 498-504. doi:10.1093/JNCI/DJAD007.

18. Michie S, Johnston M, Abraham C, Lawton R, Parker D, Walker A; "Psychological Theory" Group. Making psychological theory useful for implementing evidence based practice: a consensus approach. *Qual Saf Health Care.* 2005;14(1):26-33. doi: 10.1136/QSHC.2004.011155.

19. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci.* 2012;7(1):37. doi: 10.1186/1748-5908-7-37.

20. Michie S, Johnston M, Francis J, Hardeman W, Eccles M. From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. *Appl Psychol.* 2008;57(4):660-680. doi:10.1111/J.1464-0597.2008.00341.X

21. Damschroder LJ. Clarity out of chaos: Use of theory in implementation research. *Psychiatry Res.* 2020;283:112461. doi: 10.1016/j.psychres.2019.06.036

22. Moullin JC, Dickson KS, Stadnick NA, et al. Ten recommendations for using implementation frameworks in research and practice. *Implement Sci Commun.* 2020;1(42):1-12. doi: 10.1186/s43058-020-00023-7

23. Nilsen P. Making sense of implementation theories, models and frameworks. *Implement Sci.* 2015;10(1):53. doi:10.1186/s13012-015-0242-0

24. Atkins L, Francis J, Islam R, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implement Sci.* 2017;12(1):77. doi:10.1186/s13012-017-0605-9.

25. McGowan LJ, Powell R, French DP. How can use of the Theoretical Domains Framework be optimized in qualitative research? A rapid systematic review. *Br J Health Psychol.* 2020;25 (3):677-694. doi:10.1111/BJHP.12437.

26. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implement Sci.* 2011;6(1):42. doi: 10.1186/1748-5908-6-42. PMCID: PMC3096582

27. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. *Implement Sci.* 2012;7(1):37. doi: 10.1186/1748-5908-7-37. PMCID: PMC3483008

28. French SD, Green SE, O'Connor DA, et al. Developing theory-informed behaviour change interventions to implement evidence into practice: a systematic approach using the Theoretical Domains Framework. *Implement Sci.* 2012;7(1):38-38. doi:10.1186/1748-5908-7-38/TABLES/3.

29. Brauer ER, Long EF, Melnikow J, Ravdin PM, Ganz PA. Communicating risks of adjuvant chemotherapy for breast cancer: getting beyond the laundry list. *J Oncol Pract.* 2019;15(2): e98-e109. doi:10.1200/JOP.18.00162.

30. Brauer ER, Long EF, Petersen L, Ganz PA. Current practice patterns and gaps in guideline-concordant breast cancer survivorship care. *J Cancer Surviv* 2021;17(3):906-915. doi:10.1007/S11764-021-01152-1.

31. Creswell JW, Plano Clark VL. *Designing and Conducting Mixed Methods Research.* 3rd ed. Thousand Oaks, CA: Sage Publications; 2017.

32. Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs—principles and practices. *Health Serv Res.* 2013;48(6 Pt 2):2134-2156. doi:10.1111/1475-6773.12117.

33. Cahir C, Dombrowski SU, Kennedy MJ, Sharp L, Bennett K. Developing and validating a theoretical measure of modifiable influences on hormonal therapy medication taking behaviour in women with breast cancer. *Psychol Health.* 2017;32(10): 1308-1326. doi:10.1080/08870446.2017.1296151.

34. Huijg JM, Gebhardt WA, Crone MR, Dusseldorp E, Presseau J. Discriminant content validity of a theoretical domains framework questionnaire for use in implementation research. *Implement Sci.* 2014;9(1):11-16. doi:10.1186/1748-5908-9-11/TABLES/6.

35. Huijg JM, Gebhardt WA, Dusseldorp E, et al. Measuring determinants of implementation behavior: psychometric properties of a questionnaire based on the theoretical domains framework. *Implement Sci.* 2014;9(1):33-15. doi:10.1186/1748- 5908-9-33/TABLES/4.

36. Seward K, Wolfenden L, Wiggers J, et al. Measuring implementation behaviour of menu guidelines in the childcare setting: confirmatory factor analysis of a theoretical domains framework questionnaire (TDFQ). *Int J Behav Nutr Phys Activity.* 2017; 14(1):45-49. doi:10.1186/S12966-017-0499-6/TABLES/4.

37. Taylor N, Parveen S, Robins V, Slater B, Lawton R. Development and initial validation of the influences on patient safety behaviours questionnaire. *Implement Sci.* 2013;8(1):81. doi:10.1186/1748-5908-8-81.

38. Taylor N, Lawton R, Conner M. Development and initial validation of the determinants of physical activity questionnaire. *Int J Behav Nutr Phys Act.* 2013;10(74). doi:10.1186/1479-5868-10-74.

39. Harris PA, Taylor R, Minor BL, et al. REDCap Consortium. The REDCap consortium: building an international community of software platform partners. *J Biomed Inform.* 2019;95:103208. doi: 10.1016/J.JBI.2019.103208.

40. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2): 377-381. doi:10.1016/J.JBI.2008.08.010.

41. Yu C. *Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes.* [Order No. 3066425]. University of California, Los Angeles; 2002. https://www.proquest.com/dissertations-theses/evaluating-cutoff-criteria-model-fit-indices/docview/276287121/se-2?accountid=14512. Accessed November 10, 2021.

42. Kline RB. *Principles and Practice of Structural Equation Modeling.* 4th ed. New York, NY: The Guilford Press; 2015.

43. Boomsma A, Hoogland JJ. The robustness of LISREL modeling revisited. In: Cudeck R, Du Toit S, Sorbom D, eds. *Structural Equation Modeling: Present and Future.* Lincolnwood, IL: SSI Scientific Software; 2001:139-168.

44. Muthén LK, Muthén BO. How to use a Monte Carlo study to decide on sample size and determine power. *Struct Equ Model.* 2002;9(4):599-620. doi:10.1207/S15328007SEM0904_8

45. DeVellis R. *Scale Development: Theory and Applications.* Thousand Oaks, CA: Sage Publications.

46. Streiner DL. *Health Measurement Scales: A Practical Guide to Their Development and Use.* 5th ed. New York, NY: Oxford University Press; 2014.

47. Taylor N, Parveen S, Robins V, Slater B, Lawton R. Development and initial validation of the influences on patient safety behaviours questionnaire. *Implement Sci.* 2013;8(1):81. doi:10.1186/1748-5908-8-81.

48. McDonald RP, Ho MHR. Principles and practice in reporting structural equation analyses. *Psychol Methods*. 2002;7(1):64-82. doi:10.1037/1082-989X.7.1.64.

49. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Model*. 2009;6(1):1-55. doi:10.1080/10705519909540118

50. Bland M. *An Introduction to Medical Statistics*. 4th ed. New York, NY: Oxford University Press; 2015.

51. Hair J, Hult G, Ringle C, Sarstedt M. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks, CA: Sage Publications; 2014.

52. Fornell C, Larcker DF. Evaluating structural equation models with unobservable variables and measurement error. *J Market Res*. 1981;18(1):39-50.

53. Grady A, Seward K, Finch M, et al. Barriers and enablers to implementation of dietary guidelines in early childhood education centers in Australia: application of the theoretical domains framework. *J Nutr Educ Behav*. 2018;50(3):229-237.e1. doi:10.1016/J.JNEB.2017.09.023.

54. R Core Team. *R: A Language and Environment for Statistical Computing*. 2021. https://www.R-project.org/. Accessed June 1, 2023.

55. Michie S, Richardson M, Johnston M, et al. The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. *Ann Behav Med*. 2013;46(1):81-95. doi:10.1007/S12160-013-9486-6/TABLES/5.

56. Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. *Implement Sci*. 2015;10(1):21. doi:10.1186/s13012-015-0209-1

57. Steinmo S, Fuller C, Stone SP, Michie S. Characterising an implementation intervention in terms of behaviour change techniques and theory: the "Sepsis Six" clinical care bundle. *Implement Sci*. 2015;10(1):1-9. doi:10.1186/S13012-015-0300-7/TABLES/3.

58. Patel MS, Volpp KG, Asch DA. Nudge units to improve the delivery of health care. *N Engl J Med*. 2018;378(3):214-216. doi:10.1056/NEJMP1712984.

59. Popovitš O, Tomberg V. Mapping behavior change wheel techniques to digital behavior change interventions: review. In: Kurosu M, ed. *Human-Computer Interaction. User Experience and Behavior. HCII 2022. Lecture notes in computer science*. Cham: Springer; 2022:277-295. doi:10.1007/978-3-031-05412-9_20

60. Nekhlyudov L, Mollica MA, Jacobsen PB, Mayer DK, Shulman LN, Geiger AM. Developing a quality of cancer survivorship care framework: implications for clinical care, research, and policy. *J Natl Cancer Inst*. 2019;111(11):1120-1130. doi:10.1093/JNCI/DJZ089.

61. Gallicchio L, Tonorezos E, de Moor JS, et al. Evidence gaps in cancer survivorship care: a report from the 2019 national cancer institute cancer survivorship workshop. *J Natl Cancer Inst*. 2021;113(9):1136-1142. doi:10.1093/JNCI/DJAB049.

62. Abernethy AP, Etheredge LM, Ganz PA, et al. Rapid-learning system for cancer care. *J Clin Oncol*. 2010;28(27):4268-4274. doi:10.1200/JClinOncol.2010.28.5478.

63. Leach CR, Alfano CM, Potts J, et al. Personalized cancer follow-up care pathways: a Delphi consensus of research priorities. *J Natl Cancer Inst*. 2020;112(12):1183-1189. doi:10.1093/JNCI/DJAA053.

64. Kellerman SE, Herold J. Physician response to surveys: a review of the literature. *Am J Prev Med*. 2001;20(1):61-67. doi:10.1016/S0749-3797(00)00258-0.

65. Brtnikova M, Crane LA, Allison MA, Hurley LP, Beaty BL, Kempe A. A method for achieving high response rates in national surveys of U.S. primary care physicians. *PLoS One*. 2018;13(8):e0202755. doi:10.1371/journal.pone.0202755.