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Patient Reported Outcome Measurement Implementation in Cancer Survivors: A Systematic Review

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Abbreviation List

ADT: androgen-deprivation therapy

AUC: area under the curve

AYA: adolescent and young adult

CINAHL: Cumulative Index to Nursing and Allied Health Literature

HCP: healthcare provider

HRQoL: health-related quality of life

NR: not reported

PM&R: physical medicine and rehabilitation

PRO: patient-reported outcome

PROM: patient-reported outcome measurement

QoL: quality of life

Abstract

Purpose: Patient reported outcome measurements (PROMs) are increasingly used for cancer patients receiving active treatment, but little is known about the implementation and usefulness of PROMs in cancer survivorship care. This systematic review evaluates how cancer survivors and healthcare providers (HCPs) perceive PROM implementation in survivorship care, and how PROM implementation impacts cancer survivors' health outcomes.

Methods: We systematically searched PubMed/MEDLINE, Embase, CINAHL, Web of Science, and Cochrane Database of Systematic Reviews from database inception to February 2022 to identify randomized and nonrandomized studies of PROM implementation in cancer survivors.

Results: Based on prespecified eligibility criteria, we included 29 studies that reported on 26 unique PROMs. The studies were heterogeneous in study design, PROM instrument, patient demographics, and outcomes. Several studies found that cancer survivors and HCPs had favorable impressions of the utility of PROMs, and a few studies demonstrated that PROM implementation led to improvements in patient quality of life (QoL), with small to moderate effect sizes.

Conclusions: We found implementation of PROMs in cancer survivorship care improved health outcomes for select patient populations. Future research is needed to assess the real-world utility of PROM integration into clinical workflows and the impact of PROMs on measurable health outcomes.

Implications for Cancer Survivors: Cancer survivors accepted PROMs. When successfully implemented, PROMs can improve health outcomes after completion of active treatment. We identify multiple avenues to strengthen PROM implementation to support cancer survivors.

Keywords: patient reported outcomes, implementation, quality of life, cancer survivors

1. Background

Patient reported outcomes (PROs) are patient reports on the status of their health condition that come directly from the patient without interpretation by a clinician or member of the professional team.[1] PROs were first developed for use in clinical research to allow patients to directly report treatment related toxicities, and are used routinely in clinical trials of new therapies.[1]

PRO collection has been shown to be effective and accurate for symptom assessment of patients receiving anti-cancer therapies.[2–4] In 2017, Basch and colleagues demonstrated that implementation of PROs improved survival of patients undergoing advanced cancer treatment.[5] Others have since reported improved quality of life (QoL) with the implementation of PROs in ambulatory care and after cancer surgery.[6,7] Proposed mechanisms for these benefits include early responsiveness to patient symptoms and facilitation of patient-provider communication.[5,7]

Scientific advances in early detection and treatment for cancer have led to a growing population of cancer survivors, a population that lives with extensive chronic health problems that resulted from their cancer treatment.[8] PRO collection in cancer survivorship care could prompt conversation about lingering symptoms, identify patients who need referrals to specialty services and empower cancer survivors to manage chronic health conditions. [8] There is an urgent need to identify and implement novel tools to support cancer survivors during the transition to survivorship care, and this includes managing adverse long-term and late effects related to

disease and treatment and coordinating the exchange of information between the various clinicians involved in their care.[9–15]

There remain several outstanding questions regarding the implementation of PROMs in cancer survivorship care. One question is whether cancer survivors and HCP's view PROMs as an acceptable and valuable component of survivorship care. Another is whether using PROMs expedites or facilitates medical care and referral practices and if these affect or improve QoL for cancer survivors. We report results of a systematic review conducted to determine patients' and HCPs' acceptance of patient reported outcome measurement (PROM) implementation in the real-world setting within cancer survivorship care, and the impact of PRO collection on measurable health outcomes.

2. Methods

2.1. Search Strategy

We assembled a team of resident and fellow physicians (SS, JD, MG, MC, TE, GH, CT), attending oncologists (MR, LS), health psychologists (NL, LCH), and a medical scientist librarian (HW). We conducted a systematic literature search of five databases: PubMed/MEDLINE, Embase, CINAHL, Web of Science, and Cochrane Database of Systematic Reviews for articles published in English up to February 20, 2022. There were three major components of the keyword and subject heading search that were linked with the AND operator: quality of life outcome terms, including patient satisfaction, patient-reported outcomes, and quality of life; measurement terms, including self-report, questionnaires, and assessment tools; survivor terms, including cancer survivors and survivorship. We excluded certain study design and types including review,

editorial, or letter using the NOT operator. The search string for PubMed/MEDLINE is listed in **Appendix 1** and was adapted for the other four databases. To ensure capture of novel studies five reviewers (SS, LCH, NL, MR, and LS) conducted a manual search in June 2020 of conference proceedings from four annual meetings: American Society of Hematology 2019, International Psycho-Oncology Society 2019, American Society of Clinical Oncology 2020, and American Psychosocial Oncology Society 2020. Subsequent manual literature search was conducted to identify related peer-reviewed manuscripts to the conference proceedings. Meetings were included if they had greater than 1,000 attendees, occurred in the year prior to the manual search, and had a focus on either cancer survivors or QoL as determined by reviewers with expertise in survivorship research (SS, MR, LS). The study was registered on the International Prospective Register of Systematic Reviews (PROSPERO, ID# CRD42020157860).

2.2. Study Selection

Citations from search results were downloaded into the Covidence web-based software for systematic reviews.[16] Duplicates were removed. Each article abstract and subsequently-pulled full texts were assessed by two members of the study team to determine study eligibility based upon the Population, Intervention, Comparator, Outcomes, Study design (PICOS) criteria in **Appendix 2**. We defined cancer survivor as "as any patient who completed active cancer treatment and is no longer receiving anticancer treatment excluding adjuvant endocrine therapy that has curative intent." We excluded studies where a minority of the cohort met our cancer survivor definition and studies without original data, such as narrative reviews and commentaries. Discordant decisions were resolved through group discussion. We reported our

results following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement.[17]

2.3. Data Extraction

For articles that met criteria to undergo extraction, two members of the study team independently extracted study characteristics including trial design, comparator arm, inclusion/exclusion criteria, and primary and secondary outcomes; demographic and clinical characteristics including age, sex, type of cancer diagnosis, anti-cancer treatments, and length of time since cancer treatments; and PROM characteristics including PRO measures utilized, method of PRO delivery, number of PRO items, method of PRO data communication to clinician and patients; and PROM performance. Data were listed as not reported (NR) where not available. Reviewers also independently assessed the methodological quality of all included studies using the Quality Assessment Tool for Quantitative Studies (QATQS).[18] Using this instrument, study design, selection bias, confounders, blinding, data collection methods, and global quality were each rated as strong, moderate, weak, or not applicable for each article by two reviewers. All extracted data and quality assessments with discrepancies were reviewed and adjudication was performed by group consensus.

3. Results

3.1 Study Selection and Findings

The study identification, screening, and data extraction process is summarized in **Figure 1**. A total of 12,222 abstracts were identified after duplicates were removed. We identified 171 studies for

full manuscript review after abstract screen. The reasons for exclusions are outlined in **Figure 1**. The most common reason for exclusion was no assessment of PROM performance in the clinical setting, that is, studies where there was no collection of user feedback on PROM and/or assessment of how PROM-generated feedback influenced clinical practice. The full manuscript review yielded a total of 29 unique studies. Given the heterogeneity and limited sample sizes of identified studies, we performed descriptive synthesis of the included studies.

Of the 29 studies, 5 were randomized studies[19–23] and the remaining were non-randomized[24–40] **(Table 1)**. All 5 randomized studies evaluated QoL. Two of these 5 studies also evaluated patient or HCP acceptance.[19,21] For the entire 29 studies, the authors described 14 of the studies as feasibility studies in their study aims.[25,27,29,33–35,37,40–46] Twenty-four studies were conducted in cancer survivors only (N=24),[19–24,27–29,31–33,35–39,41–47] while the remaining (N=5) were conducted in a mixed sample of cancer survivors, patients on active treatment, and/or parents of childhood survivors.[25,26,30,34,40] The most common malignancies were breast (N=13)[21,22,24,25,27,31,32,36,39–41,43,45] and head and neck (N=6),[20,21,28,37,44,45]followed by 4 each of prostate,[19,34,36,38] colorectal,[21,23,31,45] and hematologic/lymphoma.[21,29,35,39] A mix of anti-cancer treatments were represented. One study reported the authors planned to report costs of PROM implementation, which was subsequently reported to demonstrate the PROM was not more costly than usual care.[21,48] No other studies discussed costs involved in PROM implementation.

The 29 studies implemented 26 unique PROMs **(Table 1)**. Both novel and previously validated PROMs were utilized. Eighteen of the studies evaluated multiple PRO domains,[19–

[23,27,29,32,34,35,37,39–43,45,47] 10 studies evaluated a single PRO domain,[24–26,28,30,33,36,38,44,46] and 1 study that was a conference proceeding did not report which PRO domains were assessed.[31] Of the 10 studies evaluating a single PRO domain, 7 evaluated symptom severity alone,[24,25,28,30,33,38,44] followed by 2 of sexual functioning[36,46] and 1 of health-related QoL.[26] Multiple PROM delivery methods were reported in the studies: 15 administered PROMs electronically,[20,21,37,42–44,46,23–27,30,31,34] 7 administered PROMs via telephone and/or in-person,[19,28,29,35,36,40,41] 6 did not report method of PROM delivery,[22,32,33,38,39,47] and 2 utilized a remote paper PROM delivery via mail.[45,46] **Table 1** provides an overview of how PROM findings were communicated to the patient and/or HCP. Fourteen studies did not describe how PROM data were communicated to patients;[19,24,42,45–47,28,30–33,36,38,41] 11 studies provided patients with a summary report of PRO data,[20,21,44,22,23,25,27,35,37,39,43] and 4 relied on HCP to share the data.[26,29,34,40] In addition, 7 studies included information and resources for self-management that was customized for the patient based on PRO data.[21,23–25,37,43,44]

3.2 Feasibility and Acceptability

Feasibility and acceptability were reported in 21 of the 29 studies and summarized in **Table 2**.[19,21,33–35,37,40–45,24,46,25–27,29–32] Patient acceptability was assessed via multiple methods. Fourteen studies reported percentage PROM completion rate;[21,24,42–45,29,30,32,34,35,37,40,41] 9 studies reported patient satisfaction via questionnaire;[19,25–27,33,34,37,44,46]7 studies reported PROM usability via questionnaire (N=5)[19,26,27,34,37] or system usability scale (N=2) to assess patient perception of software usability;[25,44,49] and 2 studies reported patient activation measure (PAM) as a means to assess patient knowledge, skills and confidence for self-management.[21,27,50] The percent of

patients who completed PROMs varied widely between the studies (29%-99%); of the 14 studies that reported PROM completion rates, 6 studies reported a PROM completion rate of at least 80% at one or more measurement points.[24,29,35,37,40,41][Among the 9 studies that reported patient satisfaction, 60% to 97% of patients were found to be satisfied with PROM implementation.[19,25–27,33,34,37,44,46] Of the 7 studies that reported PROM usability, 5 studies found patients reported high usability (range 76% to 83% of patients),[19,25,26,37,44] while the remaining 2 studies reported issues with difficult questions[27] and password reset on the electronic platform.[34] One study of patient activation found improved PAM scores pre-post PROM implementation,[27] while another study did not.[21]

In addition to patient acceptability, Compaci and colleagues reported 100% of general practitioners completed the necessary documentation for PROM implementation.[35] Two other studies conducted questionnaires and qualitative interviews of a sample of HCPs and found 100% of providers agreed they would like to use the PROM frequently[25] and found the PROM useful.[41] Stan and colleagues reported care team burden and reported an average of 0.9 electronic health record messages per patient over the course of the 6-month study period.[43]

Regarding PROM implementation, 9 studies reported areas for improvement: need for standardized system to integrate PROM into electronic health record and clinical workflow, need for treatment resources, need for information about symptoms, need to account for other diseases patients may have, need to limit number of questions/extent of PROM, need for reminders to complete PROM, and need to balance positive/negative aspects of being a cancer

survivor.[26,27,33,37,41,42,44–46] Only 1 study reported patient preference for optimal timing of PROM assessment and found 62% of patients preferred PROM collection prior to each visit, 14% every other month, 5% monthly, and 19% of patients reported never.[19] Shah and colleagues and Thom and colleagues reported most patients preferred to complete the PROM in clinic versus at home, 88% and 83%, respectively.[30,31]

3.3 Impact of PROM Implementation on Measurable Health Outcomes

Out of 29 included studies, 20 studies investigated how PROM implementation impacted health outcomes **(Table 3)**.[19,20,34–36,38–41,43,45,47,21–24,27,28,32,33] Of the 20 studies, 7 reported PROM implementation impact on patient QoL,[19,21,22,27,34,35,43] 6 compared PRO findings between patient or treatment groups,[23,28,32,36,41,45] 4 evaluated ability of PROM performance to detect clinical complications or correlation with existing PRO instruments,[33,38–40] and 3 reported PROM implementation impact on clinical care.[20,24,47] Eight studies compared PROs either in an intervention-control or pre-post PROM implementation study design.[19–23,27,34,43]

Four of the 7 studies that evaluated the effect of PROM implementation on patient QoL found improvements in QoL.[19,21,35,43] One study reported improved QoL in all included malignancy types, with the most PRO symptom improvements in the head and neck cancer subgroup.[21] An exploratory analysis in another study found African American men with prostate cancer reported increased sexual functioning, while the same was not seen among Caucasian men.[19] Of the 3 studies that evaluated provider practice patterns, all favored PROM implementation.[20,24,47] Patients consistently reported significantly more symptoms with the implementation of PROMs

than was documented by healthcare providers.[24,47] Among a population of head and neck cancer survivors, more symptoms were assessed during clinic visits if oncologists had access to data collected from PROs.[20] Two studies found PROM implementation could effectively detect medical complications: lymphedema in gynecologic cancer survivors and gastroenterological complications in prostate cancer survivors who received radiation therapy.[33,38]

3.4 Quality Assessment

The results of our quality assessment are shown in **Table 4**. Of the 29 studies, 5 were considered moderate quality[19,21,27,35,37] and the remainder were weak.[20,22,32–34,36,38–43,23,44–47,24–26,28–31] Blinding followed by study design were the weakest domains.

4. Discussion

Our systematic review identified significant heterogeneity in the PRO instruments, PRO domains, and outcomes reported in cancer survivorship care. When successfully implemented, both clinicians and patients had favorable opinions about the usefulness of PROM implementation. Several studies also demonstrated improved measurable health outcomes after PROM implementation for cancer survivors.

Most PROMs in this systematic review measured symptom severity, followed by QoL, although multiple PRO domains were represented. A previous consensus study proposed 12 outcome domains to guide cancer survivorship research: depression, anxiety, pain, fatigue, cognitive problems, fear of cancer recurrence or progression, functioning in everyday activities and roles,

financial toxicity, coping with cancer, overall bother from side effects, overall QoL, and overall health status.[51] These same outcome domains could be applied to survivorship care pathways. It is worth noting that one-quarter of the PROMs in the systematic review evaluated only the symptom severity, possibly due to HCP familiarity with managing symptoms.

PROM administration was most frequently performed electronically in studies included in this systematic review. This is consistent with the trend in the last decade of increased randomized trials utilizing electronic PROMs in cancer patients.[5,52–54] There were two studies that evaluated patient preference for PRO collection methods, and both reported the majority of patients prefer collection via tablet in clinic.[30,31] This patient preference to complete the PROM in clinic instead of doing so at home in advance of the visit could have implications for the clinician, who may have less time to review the data and secure necessary resources to address the patient's concerns during the clinic visit.[55] Electronic PROMs are most efficient if there is immediate scoring and direct integration of PRO data into the electronic medical record, and such data can facilitate real-time feedback to both patients and HCPs.[56,57] This is especially important in cancer survivors who are encouraged to practice self-management through symptom tracking and who interface less frequently with HCPs than patients undergoing active anti-cancer treatment.[12,58,59]

It is of interest that fewer than half of the 26 PROMs in this systematic review explicitly discussed the method of sharing PRO data with patients. A small subset of studies specifically aimed at linking resources for patients with PRO data, provided patients with tools such as a survivorship care plan and customized information and resources. Such tools are particularly helpful for

patients who recently completed anti-cancer treatment as opposed to long-term cancer survivors.[21] As self-monitoring and tracking of symptoms is considered helpful to facilitate self-management, identifying the optimal timing of PROM implementation seems essential in order to optimize the possible impact of PROMs on health outcomes.[60–62]

Selecting a PROM for unique cancer survivor populations based on risk-stratification, patient demographics, disease type, and completed treatments could be a promising approach to PRO implementation in cancer survivorship care.[63,64] We found evidence that both head and neck cancer survivors and African American male cancer survivors independently benefited from PROM implementation.[19,21] The first group may suffer from a greater burden of symptoms and the latter may be more reticent, or be given fewer opportunities to disclose private concerns about the side-effects of treatment.[65,66] A secondary analysis of one of the included studies in this systematic review found patients with low to moderate self-efficacy, high health literacy, and higher baseline symptoms scores had the greatest quality of life benefit from PROM implementation.[67]

Patient completion of the PROMs was generally high in this systematic review, albeit with a large range. A prior study of PROM implementation in multiple myeloma patients reported a 95% final PRO completion rate with the use of electronic reminders and real-time monitoring, which could represent a strategy to improve PROM completion rates.[68] The studies reported several patient-identified areas for PROM improvement, including the need to limit the number of questions. A prior review of barriers of PROM implementation in cancer patients found that time required to

317 complete PROMs was the most frequent patient-level barrier.[69] This was supported by a follow-
318 up study of one of the included PROMs in this systematic review, which found that 26% of non-
319 users did not use the PROM due to lack of time.[70] A well-received PROM must therefore balance
320 ensuring capture of necessary PROs with length of questionnaire.
321
322 Other issues raised by the studies revolved around the resources and effort required for the
323 successful integration of PROMs in clinical workflows. Among these issues are the need for robust
324 nursing support to address concerning symptoms, pathways to easily refer patients for
325 rehabilitation and mental health support when needed, and assurance PROM results are
326 expeditiously communicated to both HCP and patient. These are consistent with the MD
327 Anderson experience with PROM implementation in the survivorship program, a prior review of
328 PROMs in routine cancer care, and the recently published priority recommendations for the
329 implementation of patient-reported outcomes in clinical cancer care.[42,69,71] In one study
330 identified in our systematic review, half of the HCPs reported the electronic PROM saved time,
331 and found no substantial problems with PROM implementation on qualitative interviews.[25] The
332 authors speculate this may have been a result of the fact that patients were more likely to
333 prioritize their top three concerns and in turn this led to a more focused clinic visit, the electronic
334 PROM was well integrated into clinical workflows, and nurses closely supported each patient.[25]
335 This is consistent with a prior study that reported staff required minimal effort to implement
336 PROMs into the clinical setting.[72] A follow-up study of the van der Hout and colleagues' work
337 reported PROM implementation was not more costly than usual care.[48]
338

Our systematic review and the studies we identified have limitations. We observed substantial heterogeneity in the studies across several domains (PROM instrument and delivery, patient demographics, type of malignancy and treatments, study design) and this precluded our ability to provide a quantitative synthesis of the findings. Only 5 of the included studies were randomized and the majority were considered low quality on our bias assessment. Most of the studies did not include robust control comparator arms, did not report whether standard-of-care implementation strategies were utilized, and several utilized a pre-post design, which makes interpretation of patient health outcomes with PROM implementation challenging; however, we acknowledge that several included studies were designed as feasibility and acceptability studies and thus a comparator arms were not always helpful to achieve the study goals. We also limited our review to studies in English and our search strategy may have missed studies that would otherwise meet our study criteria. Due to the recent increase in PRO literature, it is likely that additional studies will be available the time of publication.

In conclusion, this systematic review of PROM implementation in cancer survivors found that HCPs and patients accepted PROMs, and there were certain patient populations for whom PROMs improved health outcomes after completion of active treatment. However, the included studies were heterogeneous and mostly non-randomized. We identify multiple avenues to strengthen PROM implementation in cancer survivors including identification of high-risk patients, PROM optimization to limit length and automatically provide data to patients and HCPs, integration of PROM into clinical workflows, and support for additional randomized studies.

Declarations

Author Contributions

All authors contributed to this study. All authors read and approved the final manuscript.

Conceptualization: S.S., M.R., L.C.H., L.S.

Acquisition of data: H.W.

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Preparation of manuscript: S.S., J.D., M.G., M.R., M.C., T.E., G.H., C.T., N.L., H.W., L.C.H., L.S.

Other

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Figures and Tables

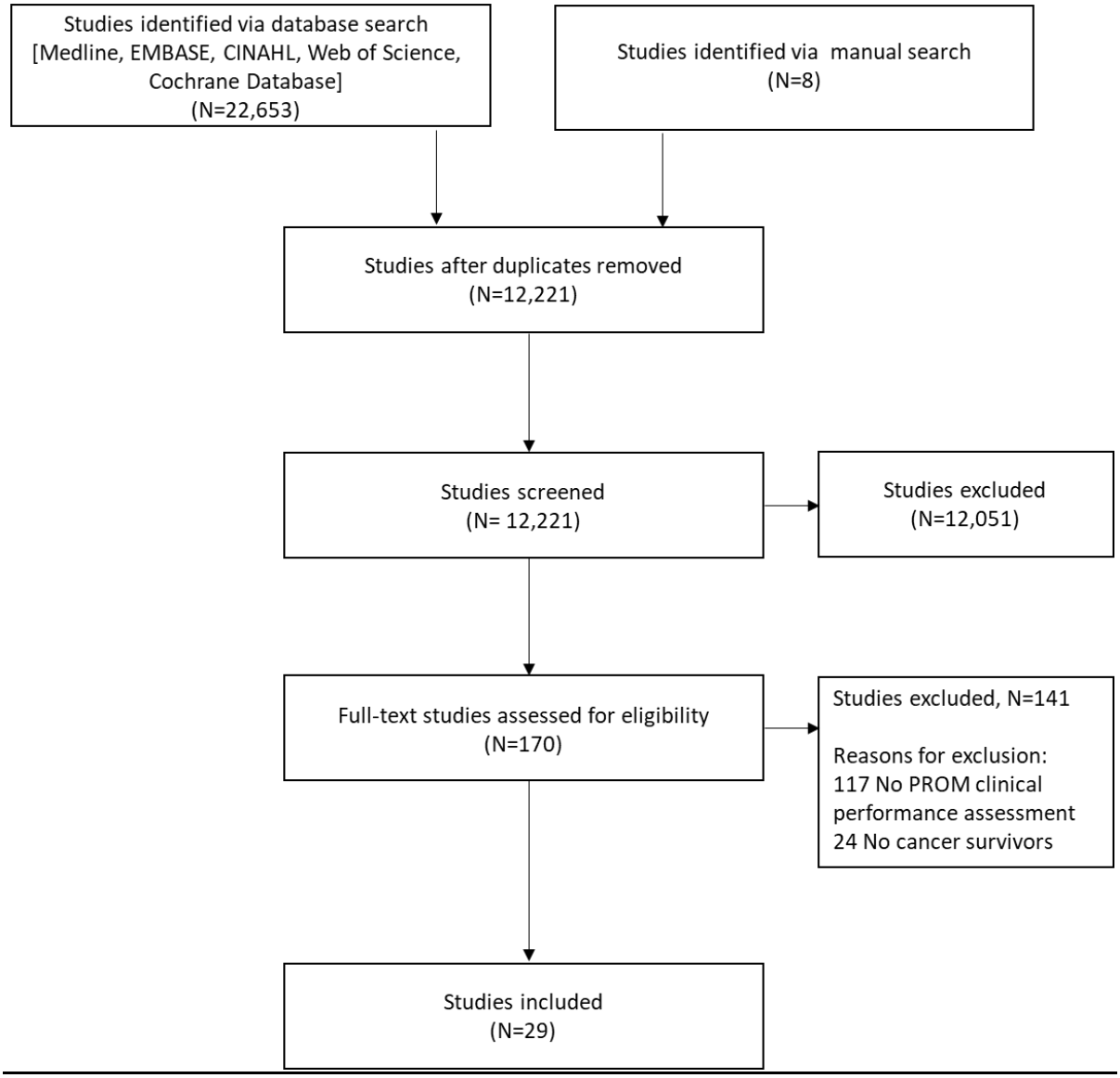

Figure 1: Summary of studies identified and reviewed. Studies were considered as "no PROM clinical performance assessment" if the study evaluated a tool where PROMs were not part of a clinical intervention or PROM development, validity, reliability was described without use in clinical care.

Abbreviations: CINAHL, Cumulative Index to Nursing and Allied Health Literature; PROM, Patient Reported Outcome Measurement

Table 1: Study and PROM Characteristics

Selected Article	Clinical Characteristics	Study Design	Study Aim	PROM Name	PROM Domains and Administration	Communication of PROM Findings
Agarwal 2021[45]	Cancer survivors, mostly breast, head and neck, and colorectal cancers N=47; mean age 58 years; 14% male Anti-cancer treatments NR. All patients completed treatment within past 3 months.	Observational, single-arm Outpatient setting	Determine the feasibility and acceptability of completing PROM at completion and 1-year after curative cancer treatment.	Mail Based Questionnaire	Financial concerns; HRQoL, physical functioning, psychological functioning, social functioning, symptom severity Paper PROM delivery via mail	Patient and HCP NR
Bock 2012[24]	Breast cancer survivors N=106; mean age 57 years Patients received anti-hormonal therapy, chemotherapy, or both. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Investigate the impact of a web-based health questionnaire on symptom reporting, physician documentation of symptoms, and symptom management.	Web Based Questionnaire	Symptom severity Electronic PROM delivery	Patient: NR HCP: summary report in patient chart

Brant 2019[25]	Endometrial, ovarian, cervical, and breast cancer survivors and active treatment N=121; mean age 56 years Anti-cancer treatments NR. Mean 21 months elapsed between cancer diagnosis and study enrollment.	Observational, single-arm Outpatient setting	Evaluate the feasibility and patient satisfaction with Carevive CPS, an individualized care plan developed from PROM data.	Carevive CPS	Symptom severity Electronic PROM delivery Recall time 1-12 weeks	Patient: print-out care plan HCP: summary report on tablet
Carter 2010[33]	Endometrial, cervical, and vulvar cancer survivors N=58; mean age 60 years All patients received surgery; other anti-cancer treatments NR. 97% of cohort ≥1 year elapsed between cancer diagnosis and study enrollment.	Observational, single-arm Outpatient setting	Determine the efficacy and feasibility of using a modified lymphedema symptom assessment tool in gynecologic cancer survivors.	Gynecologic Cancer Lymphedema Questionnaire (GCLQ)	Symptom severity Delivery method NR Recall time 4 weeks	Patient and HCP NR

Clarke 2020[34]	Prostate cancer survivors and active treatment N=41; 78% of patients of the age of 70 years Patients received or are receiving anti-hormonal therapy, surgery, and/or radiation therapy. Mean time elapsed between cancer diagnosis and study enrollment of 65 months and 59 months for the investigational and comparative arms, respectively.	Comparative, multi-arm Arm 1: intervention with PROM Arm 2: comparator with usual care Outpatient setting	Evaluate feasibility of Prostate Cancer Specific Holistic Needs Assessment (sHNA) in terms of recruitment, retention, engagement, and acceptability of the intervention.	Prostate Cancer Specific Holistic Needs Assessment (sHNA)	HRQoL, symptom severity, unmet needs Electronic PROM delivery	Patient: conversation with HCP HCP: summary report on web-based app
Compaci 2015[35]	Hodgkin and non-Hodgkin lymphoma cancer survivors N=115; mean age 55 years; 56% male All patients received anthracycline-based chemotherapy. Mean time elapsed between cancer diagnosis and study enrollment ≥ 1 year.	Observational, single-arm Inpatient and outpatient setting	Investigate whether AMA-AC (Ambulatory Medical Assistance - After Cancer) model is a feasible procedure for monitoring a patient's physical, psychological and social well-being during the first year after therapy.	Ambulatory Medical Assistance - After Cancer (AMA-AC)	HRQoL, psychological and social functioning Telephone and/or in-person PROM delivery	Patient: electronic clinical report form and oncologist summary HCP: electronic clinical report form

Crowley 2016[36]	Localized prostate cancer and non-metastatic breast cancer survivors N=114; breast cancer median age 52 years; prostate cancer median age 64 years; 51% male Anti-cancer treatments NR. Mean time elapsed between cancer diagnosis and study enrollment of 9.7 months and 5.2 months for prostate cancer and breast cancer, respectively.	Comparative, multi-arm Arm 1: breast cancer survivors Arm 2: prostate cancer survivors Outpatient setting	Test a novel questionnaire to identify the sexual concerns of the study cohort, compare their types of sexual concerns, and determine the relationship between extent of sexual concern and their QOL.	Information on Sexual Health: Your Needs After Cancer (InSYNC)	Sexual functioning Telephone and/or in-person PROM delivery	Patient and HCP NR
Davis 2013[19]	Prostate cancer survivors N=94; mean age 62 years Patients received radical prostatectomy, radiation therapy, ADT, or watchful waiting. Time elapsed between completion of anti-cancer treatment and study enrollment was 10-19 months.	Randomized trial Arm 1: intervention with PROM Arm 2: comparator with usual care Outpatient setting	Compare the impact of technology assisted symptom monitoring system versus usual care on health-related quality of life and doctor-patient communication in early-stage prostate cancer survivors.	Prostate Cancer Monitoring System (PCMS)	HRQoL, symptom severity Telephone and/or in-person PROM delivery	Patient: NR HCP: electronic alerts for worsening or severe symptoms

Duman-Lubberding 2016[37]	Head and neck cancer survivors N=56; mean age 59 years; 61% male Patients received chemoradiation and/or surgery. Mean time elapsed between completion of anti-cancer treatment and study enrollment of 12.3 months.	Pre-post, single arm Outpatient setting	Investigate the feasibility of OncoKompas in terms of adoption, implementation, and satisfaction.	OncoKompas	Physical, psychological, and social functioning; symptom severity Electronic PROM delivery Recall time 2 weeks	Patient: report utilizing color-based scheme corresponding to severity HCP: NR
Farnell 2020[38]	Prostate cancer survivors N=339; mean age 69 years All patients received radiation therapy; other anti-cancer treatments NR. Time elapsed between completion of radiation therapy and study enrollment was 1-15 months.	Observational, single-arm Outpatient setting	Test the ability of the ALERT-B questionnaire to identify subsequent gastroenterologic complications.	Assessment of Late Effects of RadioTherapy - Bowel (ALERT-B)	Symptom severity Delivery method NR	Patient and HCP NR

Fisher 2020[47]	Childhood cancer survivors, mix of cancer types N=114; mean age 34 years 95% of patients received chemotherapy. Patients also received radiation therapy, surgery, and transplant. Mean time elapsed between cancer diagnosis and study enrollment of 24 years.	Observational, single-arm Outpatient setting	Test the ability of the Coleman Survivorship Screening Tool to identify additional patient late effects and concerns not documented in the EHR.	Coleman Survivorship Screening Tool	Financial concerns; psychological functioning; sexual functioning; symptom severity Delivery method NR	Patient: NR HCP: received results but method NR
Gerstl 2021[46]	Cancer survivors, mix of cancer types N=150; median age at cancer diagnosis 25 years; 61% male Median time elapsed between completion of cancer treatment and study enrollment of 23 years.	Observational, single-arm Outpatient setting	Assess the feasibility and acceptability of the RS-PROM.	RS-PROM	Sexual functioning Electronic and paper PROM delivery	Patient and HCP NR

Kjaer 2016[20]	Head and neck cancer survivors N=266; mean age 63 years for intervention, 62 years for comparator Patients received chemoradiation, radiation therapy alone, or surgery alone. Mean time elapsed between cancer diagnosis and study enrollment of 18 months and 24 months in the intervention and comparator arms, respectively.	Randomized trial Arm 1: intervention with PROM sent to clinician and patient Arm 2: comparator with PROM not sent to clinician or patient Outpatient setting	Test the effect of longitudinal feedback on late effects reported by head and neck cancer survivors to clinicians during regular follow-up.	WebCan	HRQoL, symptom severity Electronic PROM delivery	Patient and HCP: printed 2-page report utilizing color-based scheme and bar graph corresponding to severity
Latif 2020[39]	Cancer survivors, mostly breast and hematologic cancers N=30; mean age 56 years; 40% male Anti-cancer treatments NR. Median time elapsed between cancer remission and study enrollment of 16 months.	Observational, single-arm Outpatient setting	Test a shared-care model with PM&R using PROMs to provide comprehensive care to cancer survivors.	PROMIS	Physical functioning, psychological functioning, social functioning Delivery method NR	Patient: PROM utilized to generate survivorship care plan HCP: NR

Lovrics 2008[40]	Breast cancer survivors and active treatment N=85; mean age 55 years All patients received surgery; patients also received radiation therapy, anti-hormonal therapy, and/or systemic chemotherapy. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Assess the feasibility and responsiveness of the PROM in terms of mean administration time and completion rates in a cohort of patients with breast cancer.	Health Utilities Index (HUI3)	HRQoL; physical, psychological, and social functioning Telephone and/or in-person PROM delivery	Patient: conversation with HCP via telephone HCP: NR
McDonough 2021[41]	Breast cancer survivors N=199; median age 59 years Anti-cancer treatments NR. Median time elapsed between cancer diagnosis and survey completion was 2 years.	Observational, single-arm Outpatient setting	Assess the feasibility and acceptability of the PROM at the point of care for breast cancer survivors.	NCCN-Based Questionnaire	Financial concerns; physical functioning; psychological functioning; sexual functioning; symptom severity Telephone and/or in-person PROM delivery	Patient: NR HCP: received results but method NR

McNeill 2017[26]	AYA retinoblastoma cancer survivors and parents of childhood retinoblastoma cancer survivors N=96; age and sex NR Anti-cancer treatments NR. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Evaluate cancer survivors' and clinicians' perspectives on the implementation of PROM in clinical practice.	RetinoQuest	HRQoL Electronic PROM delivery	Patient: conversation with HCP HCP: electronic report in real time
Melissant 2018[27]	Breast cancer survivors N=68; mean age 56 years Patients received surgery alone or surgery and chemoradiation. Time elapsed between completion of therapy and study enrollment was 1-24 months.	Pre-post, single arm Setting NR	Investigate feasibility and pretest-posttest differences of Oncokompas with a newly developed breast cancer.	OncoKompas	Physical, psychological, and social functioning; symptom severity Electronic PROM delivery Recall time 2 weeks	Patient: report utilizing color-based scheme corresponding to severity HCP: NR
O'Hea 2021[22]	Breast cancer survivors N=200; mean age 60 years Patients received chemotherapy, radiation, and/or surgery. 94% diagnosed with breast cancer within last 12 months.	Randomized trial Arm 1: Intervention with access to POST Arm 2: Comparator with care as usual Outpatient setting	Evaluate the impact of POST on QoL, confidence, and interest in mental health referrals.	Polaris Oncology Survivorship Transition (POST)	HRQoL; physical, psychological, social, and spiritual functioning Delivery method NR	Patient: hard copy of results HCP: received results but method NR

Palos 2020[28]	Head and neck cancer survivors N=1390; median age 63 years; 77% male Anti-cancer treatments NR. Median time elapsed between cancer diagnosis and study enrollment was 5 years.	Observational, single-arm Outpatient setting	Assess patterns of self-reported symptoms in head and neck cancer survivors and to describe the level to which these symptoms interfered with their function.	MD Anderson Symptom Inventory Head and Neck (MDASI-HN)	Symptom severity Telephone and/or in-person PROM delivery	Patient and HCP NR
Palos 2021[42]	Cancer survivors, mix of cancer types N=1278; age and sex NR Anti-cancer treatments NR. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Evaluate the feasibility and acceptance of integrating an electronic PROM into clinical care of cancer survivors.	Electronic MD Anderson Symptom Inventory (eMDASI)	Physical functioning; social functioning; symptom severity Electronic PROM delivery	Patient NR HCP: accessible in the HER
Robert 2012[29]	Childhood cancer survivors, mix of cancer types N=64; mean age 35 years; 41% male Anti-cancer treatments NR. Mean time elapsed between cancer diagnosis and study enrollment was 25 years.	Observational, single-arm Outpatient setting	Examine the feasibility, reliability, and validity of the PROM in adult survivors of pediatric cancer.	PedsQL Generic Core Scales, Cancer Module, Multidimensional Fatigue Scale	Physical, psychological, and social functioning Telephone and/or in-person PROM delivery	Patient: at discretion of HCP HCP: provided results for use during the examination

Shah 2020[30]	Cancer survivors and patients on active treatment, mix of cancer types N=134,987; age and sex NR Anti-cancer treatments NR. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Implement PRO collection in large academic health system.	PRO-CTCAE	Symptom severity Electronic PROM delivery	Patient and HCP NR
Stan 2022[43]	Breast cancer survivors N=23; mean age 50 years All anti-cancer treatment modalities included. Completed treatment within the last 12 months.	Observational, single-arm Outpatient setting	Assess the feasibility of an app-based EHR-integrated interactive care plan for breast cancer survivors.	Interactive Care Plan (ICP)	HRQoL; sexual functioning; symptom severity Electronic PROM delivery	Patient: report of symptom-specific educational materials HCP: EHR message to nurse for concerning symptoms
Teckie 2021[44]	Head and neck cancer survivors N=38; mean age 58 years; 81% male All anti-cancer treatment modalities included. Completed treatment within the last 24 months.	Observational, single-arm Outpatient setting	Evaluate the feasibility of LogPAL to help head and neck cancer survivors track and manage their posttreatment symptoms.	LogPAL	Symptom severity Electronic PROM delivery	Patient: electronic report of progress tracking, resources, and self care tips HCP: NR

Thom 2020[31]	Breast, thoracic, colorectal, and gynecologic cancer survivors N=10194; age and sex NR Anti-cancer treatments NR. Time since cancer diagnosis NR.	Observational, single-arm Outpatient setting	Assess determinants of ePRO completion across modalities and compare individual patient consistency of PROM responses.	ePRO	PROM domains NR Electronic PROM delivery	Patient: NR HCP: received results but method NR
vanderHout 2020[21]	Head and neck cancer, colorectal cancer, breast cancer, Hodgkin lymphoma, and non-Hodgkin lymphoma cancer survivors N=625; median age 65 years; 49% male All anti-cancer treatment modalities included. Median time elapsed between cancer diagnosis and study enrollment was 25 months and 29 months for the intervention and comparator, respectively.	Randomized trial Arm 1: Intervention with access to Oncokompas immediately Arm 2: Comparator with delayed access to Oncokompas after 6 months Setting NR	Evaluate the reach, usage as intended, and efficacy of Oncokompas to improve self-management among cancer survivors.	OncoKompas	Physical, psychological, and social functioning; symptom severity Electronic PROM delivery Recall time 2 weeks	Patient: report utilizing color-based scheme corresponding to severity HCP: NR

Vos 2021[23]	Colon cancer survivors N=353; median age 68 years; 63% male All patients received surgery. Median time between surgery and study inclusion was 3.6 months.	Randomized trial Arm 1: survivorship care overseen by surgeon Arm 2: survivorship care overseen by GP Arm 3: survivorship care overseen by surgeon with access to OncoKompas Arm 4: survivorship care overseen by GP with access to OncoKompas Outpatient setting	Assess the effect of OncoKompas on quality of life in colon cancer survivors.	OncoKompas	Physical, psychological, and social functioning; symptom severity Electronic PROM delivery Recall time 2 weeks	Patient: report utilizing color-based scheme corresponding to severity HCP: NR
Yang 2012[32]	Breast cancer survivors N=96; mean age 50 years All patients received surgery; other anti-cancer treatments NR. Mean time elapsed between completion of surgery and study enrollment was 15 months.	Observational, single-arm Outpatient setting	Develop a PROM from the items of the Brief Core Set Questionnaire for Breast Cancer (BCSQ-BC) and to investigate the prevalence of specific dysfunctions throughout the course of cancer and treatments.	Brief Core Set Questionnaire for Breast Cancer (BCSQ-BC)	Social functioning and symptom severity Delivery method NR Recall time 4 weeks	Patient and HCP NR

*Listed where reported. Abbreviations: ADT, androgen-deprivation therapy; AYA, adolescent and young adult; EHR, electronic health record; GP, general practioner; HCP, healthcare provider; HRQoL, health-related quality of life; NCCN, National Comprehensive Cancer Network; NR, not reported; PM&R, physical medicine and rehabilitation; PROM, patient reported outcome measurement

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Table 2: Feasibility and Acceptability

Selected Article	Method of Evaluation	Summary of Findings
Agarwal 2021[45]	Percent patients who completed PROM	62% of patients completed PROM for new patient visits; 45% for 1-year follow-up visit
Bock 2012[24]	Percent patients who completed PROM	80% patients completed PROM for new patient visits; 40% for follow-up visits.
Brant 2019[25]	Likert scales from 1 (strongly disagree) to 5 (strongly agree) to measure acceptability and satisfaction. SUS to assess software usability[49] HCP satisfaction via questionnaire and qualitative interviews.	68% recommended the PROM be used for other patients with cancer. 79% agreed or strongly agreed that the Carevive CPS platform was easy to use and 71% reported confidence using the PROM. 71% of HCP were satisfied with Carevive CPS. 100% of providers agreed they would like to use the PROM frequently.
Carter 2010[33]	Percent willingness to continue using PROM. Likert scales from 1 (not at all helpful) to 4 (extremely helpful) to measure satisfaction. Free-text comments	97% reported willingness to complete the PROM at follow-up appointments. 77% indicated the PROM was somewhat to extremely helpful in the detection of lymphedema symptoms. Comments to improve the PROM included need for treatment resources and additional information about symptoms.
Clarke 2020[34]	Percent patients who completed PROM Likert scales from 1 (strongly disagree) to 7 (strongly agree) to measure satisfaction and usability.	76% of patients completed the initial PROM, 69% the second (at 3 months), and 41% the third (at 6 months). 91% agreed to strongly agreed the PROM would be of benefit to themselves, would be helpful for the HCP, and the screen format was clear. 45% disagreed to strongly disagreed that it was easy to reset password.
Compaci 2015[35]	Percent patients who completed PROM at 12 months. Percentage of HCP who completed documentation.	90% of patients completed the PROM at 12 months. 100% of general providers completed the clinical report form designed to detect physical events.

Davis 2013[19]	10-item questionnaire to evaluate the satisfaction and usability of the PROM. Additional details NR.	88% reported the PROM questions asked were important; 83% reported that the PROM was not too long to complete. 62% reported symptom assessment would be most helpful before each visit, while 14% reported every other month. 66% reported preference for electronic PROM collection, followed by 16% for telephone.
Duman-Lubberding 2016[37]	Likert scales from 0 (poor) to 10 (good) to measure usability and satisfaction. Percent patients who completed PROM and return to use PROM in future.	60% satisfied with PROM in general; 76% found it user friendly. 98% answered all PROM. Some found PRO intrusive (21%), confusing (29%), or difficult to answer (37%). 94% viewed their well-being profile in the "Learn" section and 84% found description of results clear and understandable. Most common barrier to use was "the application did not fully take into account other diseases that participants suffered from."
Gerstl 2021[46]	Questionnaire to evaluate the satisfaction and usability of the PROM. Additional details NR.	97% agreed the PROM would be an important tool to address difficult reproductive topics with HCP; 93% were willing to answer all questions. 22% reported feeling uncomfortable with some of the questions.
Lovrics 2008[40]	Percent patients who completed PROM.	91% patients completed PROM across all time points. 99% completed PROM at 6 months; 85% completed PROM at 24 months.
McDonough 2021[41]	Percent patients who completed PROM. HCP satisfaction via questionnaire.	98% patients completed PROM. All HCP surveyed considered the PROM useful. 71% of HCP reported the PROM added less than 2 minutes to the clinic visit.
McNeill 2017[26]	Overall rating from 1 (poor) to 10 (good). Likert scales from 1 (strongly disagree) to 5 (strongly agree) to measure satisfaction and usability. Percent clinic visits where PROM results were discussed.	Mean satisfaction rate 7.8 (scale 1-10). 82% of adult participants strongly agreed the system was easy to use; 76% strongly agreed it is important to complete the PROM. PROM results were discussed with 76% of adult participants during clinic visit. Most common reasons for not discussing PROM results were technical problems (11%) or no reason for discussion such as normal profile (10%).

Melissant 2018[27]	Mean satisfaction score from 0 (poor) to 10 (good). Study-specific questions in dichotomized yes/no format to assess usability and acceptability. Pre-post patient activation measure.[50]	Mean PROM satisfaction score of 6.9 (range 0-10). Survivors treated with chemotherapy and/or radiotherapy were significantly more satisfied with PROM than those who were treated with surgery alone. 30% reported PROM difficult to answer. Most common barrier to use was "Oncokompas is too extensive." Patient activation was significantly higher after Oncokompas use than before.
Palos 2021[42]	Percent patients who completed PROM. Study-specific questions to assess HCP attitudes during pilot.	49% of patients completed the PROM. Pilot study with HCP identified areas of improvement: lack of standardized system to integrate PROM in clinical workflow, lack of web-based system to send PROM ahead of clinic visit, limited retrieval of data by HCP during clinic visit; and PRO results summarized in wrong order
Robert 2012[29]	Percent patients who completed PROM.	95% patients completed all items in the PROM.
Shah 2020[30]	Percent eligible clinic visits with completed PROM.	56% eligible clinic visits with completed PROM in initial 3 months of implementation. 77% eligible clinic visits with completed PROM after refined operational workflows and expanded PROM to all multidisciplinary clinics.
Stan 2022[43]	Percent patients who completed PROM. Number of EHR messages to HCP.	59% patients completed the PROM across all time points. Percent completion rate decreased from 78% at baseline to 48% at 6-months. There was an average of 0.9 EHR messages/patient to the HCP over the 6-month study period.
Teckie 2021[44]	Percent patients who completed PROM. SUS to assess software usability.[49] Patient satisfaction via questionnaire.	73% of PROM questionnaires were completed. Patients found the usability acceptable, with a mean SUS score of 71.9. 76% of patients agreed the PROM was useful; 76% of patients agreed they would recommend the PROM to other cancer survivors.
Thom 2020[31]	Multivariate regression to determine predictors of PROM electronic portal use.	67% patients completed PROM on tablet in clinic and 17% separately on electronic portal. Younger age, white race, less fatigue, and English as primary language were associated with electronic portal use in multivariate analyses.

vanderHout 2020[21]	Percent patients who completed PROM Intervention vs control patient activation measure.[50]	78% of patients activated their account in the intervention group; 52% used PROM as intended at least once during the 6-month follow-up period. Patient activation was not significantly different between the intervention group and the control group at 6-month follow up.
Yang 2012[32]	Percent patients who completed PROM	33% attended clinic for interview and completed the PROM before clinic; 29% completed a repeat PROM after clinic.

Abbreviations: EHR, electronic health record; HCP, healthcare provider; PROM, patient-reported outcome measurement; SUS, System Usability Scale

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Table 3: Measurable Health Outcomes

Selected Article	Population	Comparison	Measurements	Conclusions
Agarwal 2021[45]	Breast, head and neck, and colorectal cancer survivors	PROs in patients lost versus not lost to follow-up	Descriptive statistics	Patients lost to follow-up reported significantly more financial problems at baseline than those not lost to follow-up (EORTC 50 versus 17, p=0.01)
Bock 2012[24]	Breast cancer survivors	Electronic PROM versus HCP documentation in clinic note	Descriptive statistics	Patients reported significantly more symptoms using the electronic PROM than HCP documentation (mean 3.8 versus 1.8 symptoms, p<0.001).
Carter 2010[33]	Endometrial, cervical, and vulvar cancer survivors	PROM in patients with and without documented lymphedema	Area under the curve	The PROM distinguished patients with and without lymphedema with an AUC of 0.95.
Clarke 2020[34]	Prostate cancer survivors and active treatment	PROs of intervention versus control at baseline and follow-up	Descriptive statistics	There were no differences in symptoms or quality of life.
Compaci 2015[35]	Hodgkin and non-Hodgkin lymphoma cancer survivors	PROs at baseline and each follow-up	Descriptive statistics	Fewer patients had poor QoL scores at 12-months compared to 3-months for mental health (22% versus 38%) and physical health (22% versus 36%).
Crowley 2016[36]	Localized prostate cancer and non-metastatic breast cancer survivors	PROs in breast cancer survivors versus prostate cancer survivors	Descriptive statistics	Concern in losing confidence as sexual partner was more common in prostate cancer survivors compared to breast cancer survivors (48% versus 26%, p=0.02) and the only difference between the groups.
Davis 2013[19]	Prostate cancer survivors	PROs of intervention versus control at baseline and follow-up	Descriptive statistics	The sexual functioning scores increased over time for the African American men in intervention group compared to control group (UCLA PCI 40 to 55 versus 40 to 41, p=0.05).

Farnell 2020[38]	Prostate cancer survivors	PROM findings versus clinician-diagnosed medical complications	Area under the curve	84% and 96% of those patients identified by ALERT-B subsequently demonstrated clinically diagnosed complications at 6- and 12-months post-treatment, respectively.
Fisher 2020[47]	Childhood cancer survivors	PROM versus HCP documentation in clinic note	Descriptive statistics	The most frequently reported survivorship concerns on the PROM were body weight (33%), sleep (18%), and work or school concerns (18%), which were not reported in the HCP note.
Kjaer 2016[20]	Head and neck cancer survivors	HCP symptom assessment of intervention versus control at baseline and follow-up	Descriptive statistics	The oncologists assessed significantly more symptoms at all visits in the intervention group compared to the control group (6.7 versus 4.6 symptoms at visit 1; p<0.0001).
Latif 2020[39]	Cancer survivors, mostly breast and hematologic cancers	PROM versus timed up and go test	Pearson correlation coefficient	Higher PROMIS psychosocial functioning scores were associated with lower scores on the Timed Up and Go Test: satisfaction with social roles (r=-0.67, p=0.033) and companionship (r=-0.64, p=0.046).
Lovrics 2008[40]	Breast cancer survivors and active treatment	Implemented PROM versus SF-36[73]	Pearson correlation coefficient	The PROM correlated with SF-36 physical component scores (r=0.46-0.76) and mental component scores (r=0.43-0.69).
McDonough 2021[41]	Breast cancer survivors	PROs in patients within 2 years of diagnosis versus longer than 2 years of diagnosis	Descriptive statistics	There were no differences in symptoms or worry about cancer recurrence.
Melissant 2018[27]	Breast cancer survivors	Pre- and post-intervention	Descriptive statistics	There were no differences in symptoms or quality of life.

O'Hea 2021[22]	Breast cancer survivors	PROs of intervention versus control at baseline and follow-up	Descriptive statistics	There were no differences in QoL between the groups. Patients in the intervention group had higher confidence scores than the usual care group at 1-month (mean overall CSI 2.7 vs 2.4, p-value NR)
Palos 2020[28]	Head and neck cancer survivors	PROs in head and neck cancer subtypes	Descriptive statistics, statistical significance NR	There was variation in symptom distress. 9% of patients reported symptoms interfered with general activity.
Stan 2022[43]	Breast cancer survivors	PROs at baseline and each follow-up	Descriptive statistics	There was improvement in the PROMIS-29 social functioning score at 6-month follow up compared to baseline (56.8 versus 54.4, p=0.0211). Patients requested educational materials most frequently for sexual dysfunction (60%).
vanderHout 2020[21]	Head and neck cancer, colorectal cancer, breast cancer, Hodgkin lymphoma, and non-Hodgkin lymphoma cancer survivors	PROs of intervention versus control at baseline and follow-up	Descriptive statistics	There was improvement in EORTC QLQ C30 (0-100 scale) at 6-month follow up between intervention and control with difference of 2.3 points (p=0.048).
Vos 2021[23]	Colon cancer survivors	PROs of intervention versus control	Descriptive statistics	There was no change in EORTC QLQ C30 between patients who were allocated to the PROM versus not.

Yang 2012[32]	Breast cancer survivors	PROs by type and timing of surgery	Descriptive statistics	Patients with extensive surgery compared to conservative surgery reported increased joint immobility (15% versus 7%, p=0.046) and lymphatic dysfunction (17% versus 3%, p=0.035). Patients with surgery within the last year compared to surgery over 1 year ago reported impairment in muscle power (16% versus 8%, p=0.043), exercise tolerance (12% versus 4%, p=0.047), and looking after one's health (10% versus 2%, p=0.041).

Abbreviations: AUC, area under the curve; CSI, Confidence in Transitioning to Survivorship Questionnaire; EORTC QLQ C30, European Organization for the Research and Treatment of Cancer quality of life questionnaire; HCP, healthcare provider; PROM, patient-reported outcome measurement; PROMIS, Patient Reported Outcome Measurement Information System; QoL, quality of life; SF-36, 36-item short-form healthy survey; UCLA-PCI, University of California Los Angeles Prostate Cancer Index

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Table 4: Quality Ratings as assessed by Quality Assessment Tool for Quantitative Studies

Selected Article	Global Rating	Selection Bias	Study Design	Confounders	Blinding	Data Collection	Withdrawals
Agarwal 2021[45]	Weak	Moderate	Weak	NA	Weak	Strong	Moderate
Bock 2012[24]	Weak	Moderate	Weak	NA	Strong	Weak	NA
Brant 2019[25]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Carter 2010[33]	Weak	Moderate	Weak	NA	Weak	Weak	NA
Clarke 2020[34]	Weak	Weak	Moderate	Strong	Weak	Strong	Weak
Compaci 2015[35]	Moderate	Moderate	Moderate	NA	Weak	Strong	Strong
Crowley 2016[36]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Davis 2013[19]	Moderate	Moderate	Strong	Strong	Weak	Strong	Strong
Duman-Lubberding 2016[37]	Moderate	Moderate	Moderate	NA	Weak	Strong	Strong
Farnell 2020[38]	Weak	Moderate	Moderate	NA	Weak	Strong	Weak
Fisher 2020[47]	Weak	Moderate	Weak	NA	Weak	Weak	NA
Gerstl 2021[46]	Weak	Moderate	Weak	NA	Weak	Weak	NA
Kjaer 2016[20]	Weak	Moderate	Strong	Weak	Weak	Strong	Strong
Latif 2020[39]	Weak	Weak	Weak	NA	Weak	Strong	NA
Lovrics 2008[40]	Weak	Weak	Moderate	NA	Weak	Strong	Moderate
McDonough 2021[41]	Weak	Moderate	Weak	NA	Weak	Strong	NA
McNeill 2017[26]	Weak	Moderate	Weak	NA	Weak	Weak	Weak
Melissant 2018[27]	Moderate	Moderate	Moderate	NA	Weak	Strong	Strong
O'Hea 2021[22]	Weak	Moderate	Strong	Strong	Weak	Strong	Weak
Palos 2020[28]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Palos 2021[42]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Robert 2012[29]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Shah 2020[30]	Weak	Moderate	Weak	NA	Weak	Weak	Moderate
Stan 2022[43]	Weak	Moderate	Weak	NA	Weak	Strong	NA
Teckie 2021[44]	Weak	Moderate	Weak	NA	Weak	Strong	Strong
Thom 2020[31]	Weak	Moderate	Weak	NA	Weak	Weak	NA
vanderHout 2020[21]	Moderate	Weak	Strong	Strong	Moderate	Strong	Moderate
Vos 2021[23]	Weak	Weak	Strong	Strong	Weak	Strong	Strong
Yang 2012[32]	Weak	Moderate	Weak	NA	Weak	Strong	NA

Abbreviations: NA, not applicable

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