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What's missing in patient-reported outcome reporting? A scoping review and aggregated trial-level analysis of completion rates in oncology randomized controlled trials

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ABSTRACT

Background: Missing patient-reported outcome (PRO) data undermine the ability to draw robust conclusions from PRO endpoints included in cancer randomized controlled trials (RCTs). This review aimed to systematically evaluate PRO completion rates and identify trial characteristics associated with completion.
Methods: We conducted a scoping review searching for RCTs published on PubMed between 2019 and 2023. We searched for RCTs evaluating biomedical interventions in patients with solid tumors (breast, bladder, colorectal, gynecological, prostate, or lung). Trials were eligible if they used commonly applied cancer-specific PRO measures and reported information on completion. For each trial, we extracted or calculated completion rates at baseline and first post-baseline assessment, reasons for missingness, and trial characteristics. We used regression models to examine associations between trial characteristics and completion.
Findings: We identified 222 eligible trials from 9331 screened references. Mean baseline PRO completion rates were 91·3 % (control) and 92·1 % (intervention), declining to 82·1 % and 82·9 % at the first post-baseline assessment. Reasons for missing PRO data were documented in only 18 % of trials. Industry-sponsored trials exhibited significantly higher completion rates compared to non-industry-sponsored trials. Trials with double-blind designs had higher completion rates than open-label trials, while no difference between treatment arms was found. Electronic PRO assessment was not significantly associated with higher completion rates.
Interpretation: PRO completion rates in cancer RCTs remain challenging as they vary across settings, particularly beyond baseline, and reporting on missing data is often inadequate. These findings highlight the need for improved reporting and greater prioritization of PRO completion regardless of trial design.

1. Introduction

Patient-reported outcomes (PROs) are increasingly recognized as essential components of randomized controlled trials (RCTs) in oncology. By directly capturing patients' perspectives on symptoms, functioning, and quality of life (FDA, 2009), PROs complement traditional clinical endpoints and provide a more holistic understanding of treatment effects and tolerability. Regulatory agencies and health technology assessment bodies increasingly consider PRO data in benefit-risk evaluations and reimbursement decisions, further emphasizing their importance in cancer research.

However, the value of PROs depends critically on data quality.

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Missing PRO data, resulting from non-completion of PRO questionnaires, poses a persistent methodological challenge that can compromise the interpretability and validity of PRO data. In contrast to endpoints such as survival, PROs, typically included as secondary outcomes, are more vulnerable to incomplete reporting and patient attrition (European Medicines Agency, 2010). When not transparently documented or adequately handled, missing PRO data may introduce bias and reduce the utility of PRO findings for clinical and regulatory decision-making (Little et al., 2012; Mercieca-Bebber et al., 2016; Pugh et al., 2022).

To ensure interpretability, high completion rates are considered a key quality indicator for PRO data. The importance of completion rates, defined as the proportion of patients who provide assessments among those expected to do so at a specific timepoint (Coens et al., 2020) is included in evaluation frameworks of clinical benefit (e.g., (ESMO, 2022)). PRO-specific reporting guidelines such as CONSORT-PRO (Calvert et al., 2013) and SPIRIT-PRO (Calvert et al., 2018) emphasize the need for transparent reporting of PRO completion rates, including why non-completion occurred, and what methods were applied to account for it in the statistical analyses.

Despite longstanding recognition of these issues (Mercieca-Bebber et al., 2016), systematic evidence on actual PRO completion rates in cancer trials remains limited. Most prior studies have focused on whether PROs were included or reported at all, rather than on how completely they were collected. Furthermore, little is known about which trial-level characteristics, such as industry sponsorship, blinding, mode of assessment, or cancer type, may be associated with better or worse PRO completion. This gap limits efforts to improve trial design, site management, and patient engagement strategies related to PRO data.

Certain features are often assumed to influence completion. For example, electronic PRO assessment is often hypothesized to facilitate completion through automated reminders and simplified data monitoring and entry (Coons et al., 2015 Aug; Philipps et al., 2022; Smith et al., 2024), and double-blind trial designs may reduce systematic dropout or patient disengagement (Gnanasakthy et al., 2016). However, methodological evidence supporting these assumptions is scarce, and findings from individual trials are inconsistent.

This scoping review aimed to (1) summarize PRO completion rates at baseline and first post-baseline assessment in oncology RCTs, and (2) identify trial-level characteristics associated with higher or lower PRO completion rates, with particular emphasis on mode of assessment and blinding. Understanding these patterns can inform methodological standards and support the generation and reporting of more reliable PRO data from cancer clinical trials.

2. Methods

2.1. Study selection and review process

A systematic search of Medline (PubMed) was conducted to identify RCTs using PROs as endpoints in the six most prevalent solid tumor types (Siegel et al., 2022), published between January 2019 and November 2023. Search terms are reported in Supplementary Material 1. Our search strategy was based on previous work in the field (Krepper et al., 2023; van Hemelrijck et al., 2019). Guided by Munn et al. (2022), and recognizing that a risk-of-bias assessment was not pertinent to our review question, we selected a scoping review methodology. Therefore, this manuscript follows the PRISMA-ScR guidelines (Tricco et al., 2018). Trials investigating biomedical interventions and using the most commonly used PRO instruments (Efficace et al., 2021) developed by either the European Organisation for Research and Treatment of Cancer (EORTC) Quality of Life Group (QLG) or the Functional Assessment of Chronic Illness Therapy (FACIT), and providing any information on PRO completion were included. These two measurement systems were selected due to their broad adoption and established role in cancer clinical trials (Giesinger et al., 2021).

Abstract and full-text screening was performed independently by two reviewers. Disagreements were resolved by discussion or consultation with a third reviewer.

2.2. Reference matching at the trial level

Data extraction was conducted at the trial level rather than per individual publication. Following the selection of eligible records, references were matched to trials using trial registration numbers or study acronyms. Where openly available, trial protocols were also included. This approach allowed for the integration of information across all available trial documents and supported a comprehensive assessment of each trial.

2.3. Data charting and extracted trial characteristics

Data charting was conducted in reviewer pairs. Extracted trial-level variables included industry sponsorship, involvement of trial organizations or cooperative groups (not necessarily sponsorship), registration year, phase, cancer type, disease stage blinding, treatment type, control arm, sample size, and PRO endpoint classification (primary, secondary, exploratory). Original data of this study are available at Mendeley Data (https://doi.org/10.17632/nyx48k3rmy.1).

Information on missing PRO data included the completion rates at baseline and at the first assessment post-baseline, the denominator used to calculate completion rates (i.e., intention-to-treat [ITT], or number of expected questionnaires), and, if available, the reasons for missingness (e.g., administrative errors, patient refusal, or patient too sick). Given the high heterogeneity and limited comparability of subsequent PRO assessment timepoints across cancer RCTs, we extracted completion rates for the baseline and first post-baseline assessment to enhance consistency in cross-trial comparisons. Completion rates were extracted as reported by study authors when available. When not reported explicitly, they were derived from available data. When the denominator was not explicitly stated, the ITT population was used as the reference population for calculation. We evaluated completion rates for whole assessments being completed vs not completed. We did not evaluate completeness of the questionnaires themselves (i.e., whether single items or pages were skipped). All screening and data charting were conducted using DistillerSR (DistillerSR, 2025).

2.4. Statistical analysis

Characteristics of the included trials were analyzed using summary statistics. For categorical variables, distributions were presented as absolute and relative frequencies. Continuous variables were described using means and corresponding standard deviations.

To identify factors associated with higher completion rates at the first available post-baseline assessment, linear regression models were employed, adjusting for the type of denominator (ITT population vs number of expected questionnaires for the post-baseline assessment) used in calculating completion rates. Predictor variables included: date of trial registration, disease stage, cancer site, industry sponsorship, involvement of a trial organization involvement (not necessarily sponsorship), protocol availability, sample size (ITT population, per 100 patients), trial phase, whether the PRO endpoint was defined as primary, secondary, or exploratory (including not defined), treatment evaluated, type of control group (i.e., placebo-controlled vs active comparator), mode of PRO assessment, site-based PRO data collection (i.e., data collected only at study sites, and blinding. Pearson's r correlations were computed to examine linear associations among the predictor variables. We compared study characteristics of trials that reported exclusive ePRO assessment with those who did not using the chi-square test for categorical variables and t-tests for continuous variables. To further investigate potential differences between open-label and double-blinded trials (baseline, first post-baseline assessment, and between arms), we

used *t*-tests. A repeated measures ANOVA examined the effects of time (baseline vs. first post-baseline) and blinding on PRO completion. All analyses were performed using R version 4.3.1 (Core Team, 2021).

3. Results

The initial search yielded 9331 references. After title and abstract screening, 1708 articles underwent full-text review (Fig. 1). Of these, 840 were matched to 698 unique trials. After excluding 476 trials (non-EORTC/FACIT measures, pending PRO results, or no information on missing PRO data), 222 trials were included in the analysis.

3.1. Trial characteristics and reporting of missing patient-reported outcome data

The included trials were registered between 2001 and 2022, with nearly half registered between 2013 and 2017 (106/222, 47·7 %). Breast cancer was the most commonly studied cancer type (61/222, 27·5 %), followed by lung (48/222, 21·6 %) and gynecological cancers (38/222, 17·1 %). Most trials were Phase III (144/222, 64·9 %), and industry sponsorship was reported in 36·5 % of trials (81/222).

The majority of trials were open-label (146/222, 65·8 %), and just under half included patients with mainly advanced or metastatic disease (108/222, 48·6 %). Active comparator arms were used in most studies (174/222, 78·3 %), and PROs were most commonly reported as secondary endpoints (171/222, 77·0 %). Mean intention-to-treat (ITT) sample size was 578·7 (SD 787·6). Mode of PRO assessment was not reported in 48·2 % of trials (107/222). Paper-pencil was most common (59/115, 51·3 %), followed by electronic-only methods (23/115, 20·0 %). PRO data collection took place site-based in 55·4 % of trials (67/121), or both site- and field-based in 39·7 % of trials (48/121). More details can be found in Table 1.

Of the 222 trials with information on missing PRO data, only 1·8 % (4/222) reported a PRO completion rate of 100 %. Completion rates were explicitly reported in 57·7 % of trials (128/222), while 35·1 % (78/222) allowed indirect calculation, and 7·2 % (16/222) reported some information on missing data but did not report completion rates or enough information to calculate them retrospectively. Baseline PRO completion rates were available for 85·6 % or trials (190/222), averaging 90·6 % completion (SD 10·76, Table 2). At the first post-baseline time point, rates dropped to an average of 82·0 % (SD 14·37). This time point was time-driven (e.g., 90 days post-baseline) in 58·1 % (129/222) and event-driven (e.g., first day of chemotherapy cycle) in 29·2 % of trials (65/222).

The denominator used to calculate completion rates varied, which resulted in different completion rates (Table 2): In 40·0 % of trials (89/222) the number of participants with scheduled assessments was used, in 44·2 % (91/222) the ITT population. Most of which (76/91) were calculated by us using the ITT population as denominator because the number of patients with scheduled assessments was not available, however 15 trials (6·8 %) self-reported completion rates calculated based on the ITT population. Seven trials (3·4 %) used another definition of the denominator (e.g. modified ITT), and 19 (8.6 %) did not specify their method.

Reasons for missing PRO data were reported in 18.0 % of trials (40/222). The most frequently cited reasons included administration errors (24/40, 60·0 %), patients being too sick or unable to complete assessments (21/40, 52·5 %), patient refusal (17/40, 42·5 %), and missed visits (7/40, 17·5 %). Less common reasons included inability to understand the PROM (2/40, 5·0 %) and other unspecified reasons (13/40, 32·5 %). The complete study data are shown in Table S1.

3.2. Associations of patient-reported outcome measure completion rates with trial characteristics

Linear regression models controlling for the type of denominator (ITT vs. number of expected questionnaires) revealed several significant predictors of completion rates at the first post-baseline assessment time point (in percent; Table 3). Relationships between the evaluated variables are depicted in a correlation matrix (Figure S1), illustrating some overlap in content. For each additional year of trial registration, completion rates increased by 1·4 %age points ($\beta = 1{\cdot}40$, 95 % CI [0·90, 1·89], $p < {\cdot}001$). Trials with industry sponsorship showed an 8·27 %age points higher completion rate ($\beta = 8{\cdot}27$, 95 % CI [4·15, 12·38], $p < {\cdot}001$). In contrast, involvement of a trial organization (not necessarily trial sponsorship) was associated with a 7·05 %age point decrease in completion rate ($\beta = -7{\cdot}05$, 95 % CI [-11·15, −2·95], $p = {\cdot}001$). Open-label trials had a 6·5 %age point lower completion rate compared to double-blinded trials ($\beta = -6{\cdot}50$, 95 % CI [-11·25, −1·75], $p = {\cdot}008$). Notably, exclusive use of electronic PRO assessment had no significant effect on completion rates at the first post-baseline assessment time point ($p = {\cdot}476$). Trials reporting ePRO assessment significantly differed from those employing other modes of PRO assessment (Table S2): Most notably, trials using electronic assessment were registered more

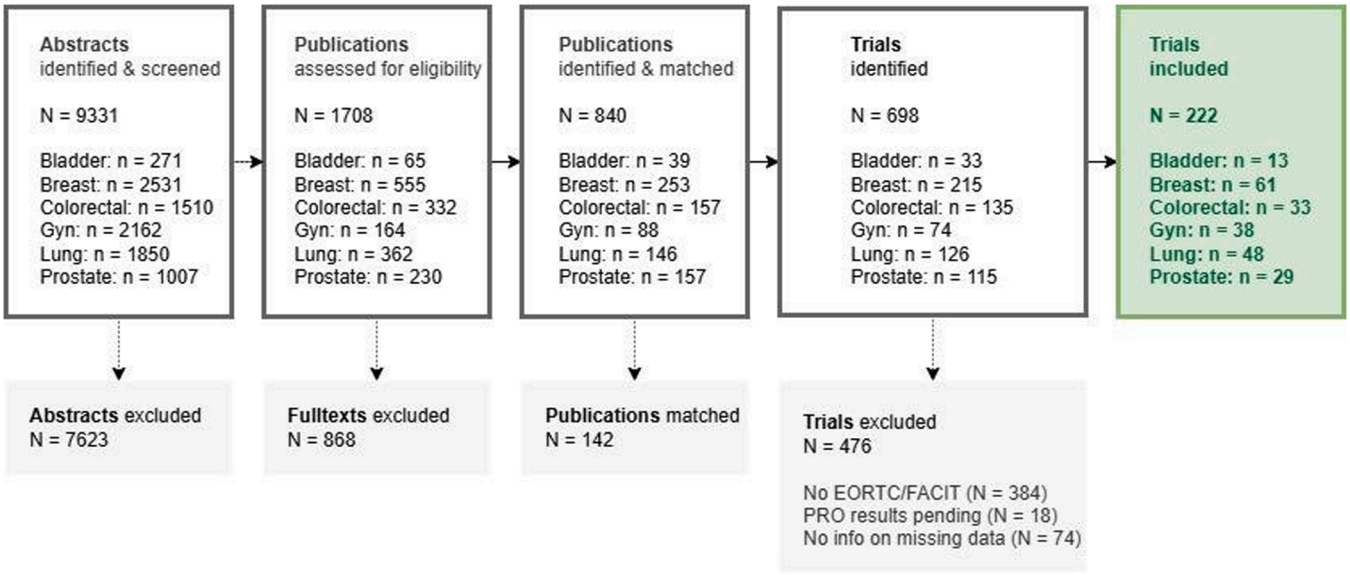

Fig. 1. PRISMA Flow Chart. *Note:* Gyn refers to gynecological cancers.

Table 1
Trial characteristics.

Variable	N = 222
Year of trial registration (N, %)	
2018–2022	20 (9·0)
2013–2017	106 (47·7)
2008–2012	51 (23.0)
Before 2008	26 (11·7)
No registration date	19 (8·6)
Cancer site (N, %)	
Breast cancer	61 (27·5)
Lung cancer	48 (21·6)
Gynecological cancer	38 (17·1)
Colorectal cancer	33 (14·9)
Prostate cancer	29 (13·1)
Bladder cancer	13 (5·9)
Trial organization involvement (N, %)	
Yes	71 (32·0)
No	151 (68·0)
Industry sponsor (N, %)	
Yes	81 (36·5)
No	141 (73·5)
Trial phase (N, %)	
II	45 (20·3)
III	144 (64·9)
IV	3 (1·4)
not reported	30 (13·5)
Treatment evaluated (multiple could apply; N, %)	
Targeted therapy	69 (31·1)
Chemotherapy	63 (28·4)
Other treatment	39 (17·6)
Radiotherapy	30 (13·5)
Surgery	29 (13·1)
Hormonal therapy	19 (8·6)
Immunotherapy	17 (7·7)
Control condition (N, %)	
Active comparator	174 (78·3)
Placebo controlled	48 (21·6)
PRO endpoint (N, %)	
Primary	22 (9·9)
Secondary	171 (77·0)
Exploratory (including not defined)	29 (13·1)
PROMs used (multiple could apply; N, %)	
EORTC questionnaires	151 (68·0)
FACIT questionnaires	78 (35·1)
ITT sample size (mean (SD))	578·74 (787·6)
Blinding (N, %)	
No blinding, open label	146 (65·8)
Yes, double blinded	52 (23·5)
Yes, single blinded	5 (2·3)
Not reported	19 (8·6)
Disease stage (N, %)	
Mainly metastatic/advanced	108 (48·6)
Mainly non-metastatic/local	77 (34·7)
Both	27 (12·2)
Not reported	10 (4·5)
Mode of PRO assessment reported (N, %)	
No	107 (48·2)
Yes	115 (51·8)
Paper-pencil only	59 (51·3[1])
Electronic PRO assessment only	23 (20·0[1])
Mixed-mode assessment (paper-pencil and non-automated telephone interviews)	16 (3·5[1])
Mixed-mode assessment (electronic and paper-pencil)	13 (11·3[1])
Other (eg, non-automated telephone scripts)	4 (3·5[1])
Location of PRO data collection reported (N, %)	
No	101 (45·5)
Yes	121 (54·5)
Site-based (ie, at the study sites only)	67 (55·4[1])
Field-based (ie, remote)	6 (5·0[1])
Both site-based and field-based	48 (39·7[1])

Note: PRO = Patient-reported outcome; PROM = Patient-reported outcome measure; EORTC = European Organisation for Research and Treatment of Cancer; FACIT = Functional Assessment of Chronic Illness Therapy; ITT = Intention to treat population; [1] valid percent, i.e. not including missing information

recently, more frequently sponsored by industry, and more commonly enrolled patients with advanced disease compared to trials using other, non-electronic modes.

As a sensitivity analysis, we evaluated the same models for the baseline completion rates (Table S3), showing mostly similar results. In contrast to the completion rates at first post-baseline assessment, trial organization involvement and lung cancer population were not significant predictors of baseline completion rates. Site-based assessment was a significant predictor of higher completion rates.

3.3. Completion rates in open-label versus double blind trials

A repeated measures ANOVA showed a significant main effect of time ($F(1151) = 55{\cdot}57$, $p < {\cdot}001$, $\eta^2_p = {\cdot}27$), indicating a significant drop in completion rates from baseline to first post-baseline assessment. No significant time × blinding interaction was found ($F(1151) = 3{\cdot}09$, $p = {\cdot}081$), suggesting the decline did not differ between open-label ($M = -9{\cdot}63$) and double-blind ($M = -6{\cdot}03$) trials. However, a significant between-subjects effect for blinding ($F(1151) = 8{\cdot}42$, $p = {\cdot}004$, $\eta^2_p = {\cdot}05$) indicated overall higher completion rates in double-blind ($M = 88{\cdot}10$) vs. open-label trials ($M = 80{\cdot}68$) regardless of time. This difference was already present at baseline ($t(132{\cdot}75) = 2{\cdot}63$, $p = {\cdot}010$; open-label $M = 90{\cdot}23$, double-blind $M = 93{\cdot}88$). No significant difference between intervention and control arms at first post-baseline assessment was found in either open-label ($p = {\cdot}543$) or double-blind trials ($p = {\cdot}853$) (Fig. 2).

4. Discussion

This scoping review examined the reporting of PRO completion rates in solid cancer RCTs and explored which trial-level characteristics are associated with completion rates. Across 222 RCTs using EORTC or FACIT instruments, we found that baseline completion rates were generally high (~92 %) but declined already at the first post-baseline assessment (~82 %). Reporting of PRO completion was inconsistent, with only a minority of trials reporting the reasons for missingness or clearly defining how completion rates were calculated. Trial features such as industry sponsorship or type of blinding were associated with differences in completion rates, whereas the use of electronic PRO assessment was not.

One of the first issues to consider in interpreting PRO completion rates is how they are calculated. While some studies used the number of patients with scheduled assessments, others relied on the ITT population, and in many cases, the denominator was not explicitly defined. Due to inconsistent reporting, we calculated completion rates based on the ITT population as the denominator where necessary, recognizing this approach is suboptimal. Using the ITT population underestimates completion rates, particularly when dropout or ineligibility post-baseline is substantial, as shown in our results. Standardizing how completion rates are reported and calculated is essential for improving the interpretability and comparability of PRO data. Following recommendations from the SISAQOL Consortium (Coens et al., 2020), we support the use of a variable denominator that reflects the number of patients still expected to provide data at a given timepoint (which may be distinguished from an available data rate, which is based on the ITT population).

Another much-discussed topic is the role of assessment mode on PRO completion. In our review, electronic PRO assessment was not associated with higher completion rates at the evaluated time points. Existing evidence on whether electronic assessment improves completion rates, with comparable definitions to those applied in our analysis, is limited and mixed, with most data derived from single-study comparisons (Barentsz et al., 2014; Dumais et al., 2019; Retzer et al., 2021; Yu et al., 2021). Our analysis also focused on whether assessments were fully completed, rather than capturing more granular or other potential benefits of electronic data collection such as improved item-level

Table 2
Patient-reported outcome measure completion rates by study arm and time point.

	Total		Intervention arm		Control arm	
	Available for N trials (%)	Mean completion rate (SD)	Available for N trials (%)	Mean completion rate (SD)	Available for N trials (%)	Mean completion rate (SD)
Baseline						
Overall[1]	190 (85.6)	90.61 (10.8)	157 (70.7)	92.08 (9.7)	157 (70.7)	91.28 (10.3)
Denominator: Scheduled assessments	85 (95.5)	93.28 (7.89)	69 (77.5)	94.18 (7.63)	69 (77.5)	93.76 (7.85)
Denominator: ITT	84 (92.3)	88.79 (12.43)	74 (81.3)	90.65 (11.29)	74 (81.3)	89.35 (11.89)
First post-baseline assessment						
Overall[1]	179 (80.6)	82.02 (14.4)	155 (69.8)	82.94 (13.7)	155 (69.8)	82.14 (14.3)
Denominator: Scheduled assessments	79 (88.8)	87.67 (9.49)	66 (74.2)	88.65 (9.37)	66 (74.2)	87.94 (10.09)
Denominator: ITT	83 (91.2)	78.04 (15.62)	75 (82.4)	79.28 (14.96)	75 (82.4)	78.27 (15.92)

Note: [1] all available completion rates, including those based on unspecified denominators; ITT = Intention to treat analysis sample.

Table 3
Associations of completion rates at first post-baseline assessment with trial characteristics.

	Univariate (Corrected for denominator)			
		95 % CI		
Variable[1]	Beta	*LL*	*UL*	*p*
Denominator of the completion rate (number of questionnaires expected vs ITT)	**10·12**	**6·11**	**14·13**	**< 0·001**
Date of trial registration (per year)	**1·40**	**0·9**	**1·89**	**< 0·001**
Advanced cancer population vs other populations[2]	0·33	-3·68	4·34	0·872
Cancer site (Reference: Colorectal)				
Bladder	1·99	-7·12	11·09	0·667
Breast	**10·09**	**3·46**	**16·71**	**0·003**
Gynecological	2·54	-4·67	9·74	0·488
Lung	**8·33**	**1·41**	**15·26**	**0·019**
Prostate	6·72	-1·21	14·65	0·096
Industry sponsor vs. no industry sponsor	**8·27**	**4·15**	**12·38**	**< 0·001**
Trial organisation involvement vs. no involvement	**-7·05**	**-11·15**	**-2·95**	**0·001**
Protocol available vs. no protocol available	3·45	-0·60	7·50	0·095
Sample size ITT (per 100 patients)	-0·14	-0·44	0·16	0·360
Trial phase (Reference: II)				
III	1·34	-3·74	6·42	0·604
Other phase ('not reported' or phase IV[3]	6·07	-0·65	12·78	0·076
PRO endpoint (Reference: Primary)				
Secondary	-2·77	-9·16	3·62	0·393
Exploratory (including not defined)	2·13	-6·10	10·36	0·610
Treatment evaluated[4]				
Surgery	-4·67	-10·69	1·35	0·127
Radiotherapy	-0·23	-5·98	5·53	0·938
Chemotherapy	**-7·69**	**-12·03**	**-3·35**	**0·001**
Targeted therapy	0·55	-3·82	4·92	0·804
Hormonal therapy	2·36	-4·63	9·35	0·507
Immunotherapy	5·06	-3·00	13·12	0·217
Placebo controlled vs. active comparator	**5·69**	**0·74**	**10·63**	**0·024**
Open label vs. double blind	**-6·5**	**-11·25**	**-1·75**	**0·008**
Mode of assessment and location				
Electronic PRO assessment vs. other modes	2·56	-4·51	9·63	0·476
Paper assessment vs. other modes	-1·63	-5·82	2·55	0·442
Site-based PRO data collection (ie, at the study sites only) vs. other modes	-0·86	-6·23	4·50	0·750

Note. Dependent variable: Completion rates at first available assessment after baseline (continuous);
CI: Confidence interval; LL: lower level; UL: upper level,
[1] Constants are not shown.
[2] Binary; at least 80 % of the trial sample consists of patients with mainly metastatic or advanced cancer
[3] Trial phase IV and 'not reported' combined into single category as both most likely contain most post market trials
[4] Binary. Multiple treatments could be evaluated

completeness or auditability. Moreover, trials using ePRO assessment differed significantly from those that did not in many of the study characteristics evaluated. For instance, the majority of studies using electronic assessment reported to administer PROs on-site, potentially limiting the applicability of some commonly cited advantages of electronic PRO assessment systems, such as improved compliance with unsupervised, high-frequency assessments (e.g., daily diaries) or enhanced auditability (Stone, 2002). Our findings suggest that other theoretical benefits of electronic PRO assessment, such as real-time monitoring of patient-level or site-level data completion, may not be fully implemented or prioritized in practice. This may reflect a broader issue of PROs being deprioritized relative to primary clinical endpoints (Retzer et al., 2021), rather than limitations in the technical capabilities of electronic assessment. Further research is warranted to evaluate how the operational use of electronic PRO assessment systems influences data quality and to identify strategies for leveraging these tools to improve PRO completion rates.

The influence of open-label design on the integrity and interpretability of PROs has been a subject of ongoing debate. A 2022 review found no significant difference in the proportion of open-label versus

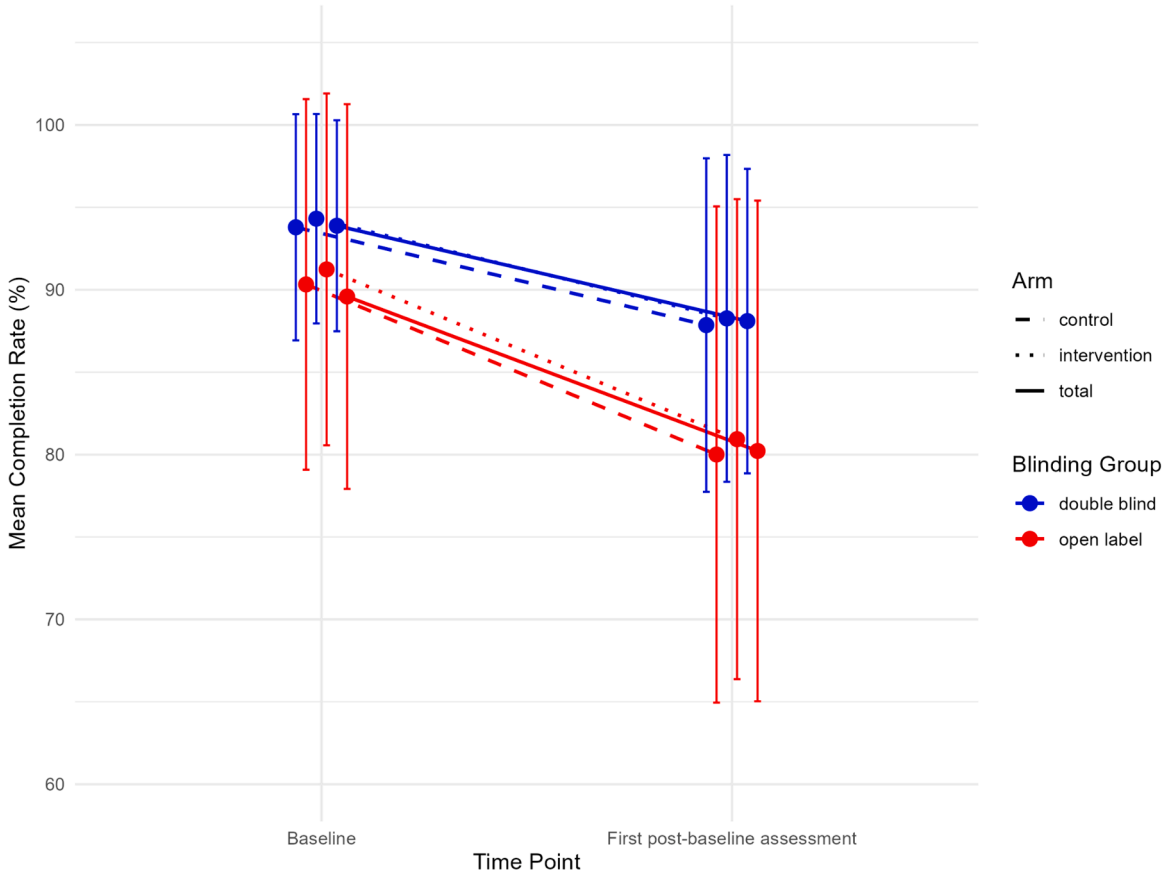

Fig. 2. Trajectories of completion rates from baseline to first post-baseline assessment for open-label and double-blind trials.

blinded trials favoring the experimental treatment with regard to PRO results, suggesting limited systematic bias in treatment effect estimates (Efficace et al., 2022). Another, more detailed review of trial data submitted for approval to the FDA Roydhouse et al. (2019) reported that while most trials had comparable PRO completion rates between arms, large between-arm discrepancies (i.e., ≥10 %), particularly those favoring the experimental arm, were more frequently observed in open-label settings. In contrast, Anota et al. (2022) found no association between trial blinding and PRO completion rates or baseline scores. From a regulatory perspective, Teixeira et al. (2022) noted that study design, in particular blinding, remains a key consideration for the acceptability of PRO data in support of label claims, with double-blind designs being generally preferred. In our review, the decline in PRO completion rates observed in open-label trials occurred similarly in both arms, suggesting that the reduction may not be due to differential patient motivation or dissatisfaction, but rather to broader design-related factors (Little et al., 2012). These may include diminished perceived data value by patients, lower site engagement, or contextual implementation differences. These findings reinforce the need for targeted methodological strategies to uphold PRO data quality in open-label settings (van der Weijst et al., 2024).

This study has several limitations. First, the literature search was restricted to a single database (PubMed), potentially omitting relevant studies indexed elsewhere. Second, the exact timing of the first post-baseline PRO assessment was not assessed, limiting our ability to determine whether systematic differences in assessment timing existed between trials across different trial characteristics. Due to feasibility constraints, analyses were limited to the first two assessment time points, where PRO completion rates remained relatively high. While this approach allowed for consistent extraction across a large sample of trials, it inevitably reduces the granularity of longitudinal insights. Declines in PRO completion observed soon after baseline may partly reflect early treatment effects or patient burden, rather than design-related factors such as blinding or sponsorship. Future research should therefore investigate additional and later follow-up assessments to better disentangle clinical from methodological influences and to provide a more nuanced understanding of PRO completion dynamics over time. Third, using univariate regression analyses limits the ability to account for potential confounding between correlated trial characteristics (e.g., industry sponsorship and trial organization involvement), meaning that observed associations cannot be interpreted as independent effects. This approach also does not capture potential joint or interactive influences of multiple design factors and may over- or underestimate associations. However, we deliberately applied this approach for conceptual and methodological reasons. The examined trial-level characteristics represent distinct design features rather than elements of a single causal framework, making separate analyses more interpretable. Moreover, substantial interrelations among predictors could introduce multicollinearity and obscure meaningful effects in a multifactorial model. Given the exploratory scope and limited sample size, univariate models provided a more transparent and stable basis for identifying associations. Finally, the reported effect sizes (β-coefficients) are dependent on variable coding and should be interpreted with caution. Overall, the regression analyses should be considered as exploratory; the findings are hypothesis-generating, and validating in future confirmatory studies is encouraged. Finally, our review reflects trial publications available up to late 2023. Combined with the typical lag between trial registration and publication, illustrated by the fact that 82.4 % of included trials were registered before 2018, this means that the most recent innovations in trial conduct, including wider use of electronic PRO assessment and remote data capture, may not be fully represented in our dataset.

In conclusion, transparent reporting of PRO completion rates, including clear definitions of denominators and reasons for missingness, is essential for data quality and handling of missing PRO data.

Inadequate reporting (e.g., on the reasons for missingness as included in the CONSORT-PRO guideline Item 13a) compromises the interpretability and utility of PRO data, ultimately limiting its influence on regulatory and policy decision-making. Strengthening adherence to established reporting frameworks, including CONSORT-PRO and SPIRIT-PRO, and alignment with emerging initiatives such as SISAQOL-IMI, is essential to enhance transparency, comparability, and the overall impact of PRO research. Despite proposed advantages, no association was observed between the use of electronic PRO assessment and higher completion rates, suggesting that anticipated benefits may not yet be consistently realized. Overall, PRO completion rates were lower in open-label compared to double-blind trials, potentially reflecting broader differences in trial design, resource allocation (e.g., industry sponsorship), and regulatory demands. The findings of this review highlight the need for improved reporting and greater prioritization of PRO completion independent of trial design.

Many of the reporting deficiencies and trial characteristics associated with lower PRO completion identified in our analysis reflect decisions at a study design stage. Robust PRO reporting depends on the prospective specification of objectives, instrument selection, timing of assessments, and analytic strategies within the study protocol. Without thoughtful integration of PRO considerations from the onset, many methodological and reporting challenges cannot be adequately addressed at the time of analysis. Therefore, greater attention to the quality and conceptual rigor of PRO components during protocol development is essential to enhance data quality, interpretability, and transparency in PRO research.

Critical view

Missing patient-reported outcome (PRO) data undermine the ability to draw robust conclusions from PRO endpoints included in cancer randomized controlled trials (RCTs) and are widely recognized as a key barrier in quality of life research. While prior work has documented that reporting of PRO completion rates is often poor, the extent of missing data and the trial-level factors associated with completion rates have not been systematically studied.

This scoping review provides large-scale evidence on PRO completion rates in oncology RCTs. From 222 trials, we extracted completion rate data and assessed reporting practices against EQUATOR-based standards. We found that reporting on missing data remains inconsistent and incomplete. In addition to describing completion rates, we conducted aggregated analyses of trial-level determinants thereof. Industry-sponsored trials (compared to non-industry sponsored) and double-blind designs (compared to open-label designs) were associated with higher completion rates, whereas electronic PRO assessment was not linked to improved rates (compared to paper). These findings provide nuance to ongoing debates about potential bias in open-label PRO data and about the role of electronic assessment in improving completion rates.

Our findings establish, for the first time, a benchmark for PRO completion rates in cancer RCTs and identify trial characteristics linked to better or worse completion rates. Improved reporting of completion rates and missing PRO data, in line with EQUATOR recommendations, and targeted strategies to minimize missing PRO data are critical to strengthen the interpretability and clinical impact of PRO endpoints in oncology trials.

CRediT authorship contribution statement

Conceptualization: D.K., J.G., M.P., B.H., D.F., J.L.
Methodology: D.K., J.G., J.L.
Data curation: N.H., D.K., J.L.
Formal analysis: N.H., J.L.
Review process and data charting: D.K., N.H., L.W., A.M., C.S., S.V., J.L.
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All authors read and approved the final manuscript.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT-4o, OpenAI, 2025 in order to improve the readability and language of the work. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Declaration of Competing Interest

NJH reports employment by ACMIT GmbH - Austrian Center for Medical Innovation and Technology, Wiener Neustadt, Austria, which was not involved in this study. BH owns intellectual property rights to the software CHES, a software for electronic data capture. JL reports consultancy for Evaluation Software Development and a research grant from Takeda, both outside of the submitted work. All remaining authors declare no conflicts of interest.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.critrevonc.2025.105100.

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