BJU Int 2026; **138:** Supplement 2: S88–S96 doi:10.1111/bju.70225

Check for updates

BJUI
BJU International

Original Article

The prostate cancer electronic health (eHealth) literacy instrument: a tool for eHealth design and patient communication

Stuart Robert Jackson[1], Paul Yu[2], Steven Sowter[3], Stefano Occhipinti[9,10], Suzanne Chambers[4,5,6], Scott Leslie[7,8] and Manish I. Patel[1,2]

[1]The University of Sydney, Camperdown, [2]Department of Urology Westmead Hospital, University of Sydney, [3]University of New South Wales, [4]Faculty of Health Sciences, Australian Catholic University, [5]Faculty of Health, University of Technology, [6]St Vincent's Health Network, [7]RPA Institute of Academic Surgery, Royal Prince Alfred Hospital, [8]Faculty of Health and Medicine, University of Sydney, Sydney, New South Wales, [9]School of Applied Psychology, Griffith University, Brisbane, Queensland, Australia, and [10]Department of English and Communication, International Research Centre for the Advancement of Health Communication, Hong Kong Polytechnic University, Hong Kong, China

Objective

To describe the development and validation of the Prostate Cancer Electronic Health (eHealth) Literacy Instrument (P-CeHLI). This is in response to: (i) a lack of clear and validated eHealth literacy measurement for men with prostate cancer; (ii) the unique information processing, decision making, and digital communication experience of men with prostate cancer as a single sex, older age, cancer cohort; and (iii) modern eHealth literacy theory and research, which now greatly considers the transactional nature of web technologies and digital communicative practice.

Patients and Methods

A total of 349 men with prostate cancer participated in a three-phase, longitudinal instrument development study. This was undertaken with end-user participation, and a multidisciplinary and international collaboration of prostate cancer, psycho-oncology, communication, and biostatistics experts. Exploratory and confirmatory factor analysis evaluated construct validity. The P-CeHLI was compared to respondents' eHealth literacy measured with the Transactional eHealth Literacy Instrument (TeHLI), as well as respondent eHealth utilisation and sociodemographic characteristics.

Results

A four-factor model was demonstrated with acceptable fit properties (root mean square error of approximation = 0.074; comparative fit index = 0.931; Tucker–Lewis index = 0.924; standardised root mean square residual = 0.051) and excellent reliability (subscale alphas of 0.85–0.96). Domains of the P-CeHLI included cancer-specific functional, communicative, critical and translational eHealth literacy. Association between the scores of the scales and respondents' characteristics were similar; however, for all four subdomains, the P-CeHLI added significant predictive value when assessing eHealth use in men with prostate cancer whilst controlling for respective TeHLI scores.

Conclusion

The P-CeHLI establishes a novel cancer-specific multidomain eHealth literacy instrument, validated in men with prostate cancer, and positioned to respond to their needs in the digital cancer care era. The P-CeHLI provides a new opportunity for clinicians and researchers to accurately identify and enhance the eHealth literacy skills of patients with prostate cancer, which may improve future clinical outcomes through digital intervention and improved communicative practice.

Keywords

electronic (e)Health, digital, internet, prostate, cancer, literacy, communication

© 2026 The Author(s).
BJU International published by John Wiley & Sons Ltd on behalf of BJU International. www.bjui.org
wileyonlinelibrary.com
This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

Introduction

For men with prostate cancer, electronic health (eHealth) technologies have become education, communication and intervention tools, used for screening, treatment and support [1]. This has seen an expansion of interest in eHealth literacy and impacts on cancer outcomes [2]. eHealth literacy is a super-literacy that relies on an individual's ability to use digital technologies for their healthcare wants and needs [3]. Modern conceptualisations of eHealth literacy, such as the Transactional Model of eHealth Literacy (TMeHL), now consider closely the interpersonal skill sets necessary for health-based digital communication, interaction, and translation [4]. This is critical in modern prostate cancer care, with increasing digital communicative reliance of patients.

Rising with digital communication is evidence of persistent poor-quality information about prostate cancer via eHealth media, especially through social media where misinformation and unregulated communities influence care and decision-making of patients [5,6]. Compounding this, our team has recently demonstrated that the current understanding of patients with prostate cancer technology use, and eHealth literacy is limited [7,8]. Currently, men with prostate cancer have only had their eHealth literacy assessed with non-validated survey items, or historical instruments that only consider foundational Web 1.0 technologies and eHealth literacy theory (e.g., eHealth Literacy Scale [eHEALS]) [7]. Moreover, these measures have only been conducted in patients with prostate cancer as part of mixed cohorts, with no assessment of patients with prostate cancer alone with any validated instrument.

In parallel, it is known that men with prostate cancer experience cancer- and non-cancer-specific cognitive and sociocultural influences that may affect comprehension, decision making, information processing and higher order functions, as well as their technology use and engagement [9–13]. As a result of these issues, we hold significant concerns that patients with prostate cancer as a unique, elderly, male only, and cancer-specific population have not experienced adequate assessment of their eHealth literacy. Analogous to basic health, cancer, numerical and written literacies, there is a subset of men who are likely at risk of poor prostate cancer outcomes as a result of poor eHealth literacy, but that are yet to be appropriately identified or assisted, due to a lack of current and appropriate measures [7].

In response to these issues, this study describes the development and validation of the Prostate Cancer eHealth Literacy Instrument (P-CeHLI), a multidimensional instrument grounded in modern eHealth literacy theory, which is reflective of the needs and experience of the prostate cancer survivorship population.

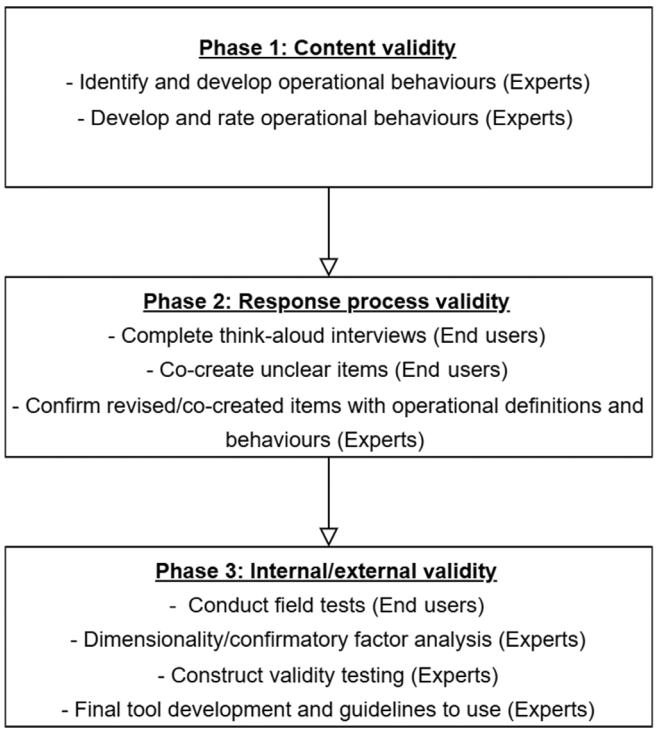
Patients and Methods

Study Design and Procedure

This study was approved by the University of Sydney Human Ethics Research Committee (project identifier: 2022/617). All participants were provided a participant information sheet and consent form and contacted by phone to discuss the study with a research coordinator prior to enrolment. Scale development and design was guided by Boateng et al. [14]. Figure 1 illustrates the three-phase development process. Phase 1 established content validity, whereby empirical evidence was used to deductively establish operational behaviours and wording of items used to measure them. Phase 2 comprised of validity testing to ensure that item responses were consistent with each domain. Phase 3 included internal and external validity testing.

This work considers and triangulates historical literature, feedback of patients, and experts in its design. Inclusion of these parties strengthens the tool's generalisability and applicability to men with prostate cancer and is reflective of the prostate cancer community's current experience and needs. Experts involved in tool development had experience in prostate cancer care, uro-oncology, surgery, psycho-oncology, eHealth intervention research and design, and qualitative and quantitative analysis for survey/instrument design.

Fig. 1 Flow chart of instrument development.



© 2026 The Author(s). *BJU International* published by John Wiley & Sons Ltd on behalf of BJU International.

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Phase 1: Domain and Item Construction

Step 1.1. Identifying Operational Behaviours and Preliminary Items

Domains for operational behaviours were grounded in modern eHealth literacy theory via the TMeHL, and its related Transactional eHealth Literacy Instrument (TeHLI), which have received increasing attention as modern representations of eHealth literacy theory and assessment [4,15]. Domains measured general functional, communicative, critical and translational eHealth literacies. Cancer-related operational behaviours that reflect each dimension were developed and refined from literature identified through previous bibliometric analysis and systematic review [6,7]. Broadly, this literature focussed on men with prostate cancer's use of eHealth technology and on-line information sources, eHealth and digital health literacy, and its measurement by a gamut of existing eHealth literacy scales and items across both Web 1.0 (e.g., eHEALS) and Web 2.0/3.0 (e.g., TeHLI) relevance. Each operational behaviour included in this study is related to aspects of cancer care commonly undertaken with eHealth media (see Fig. S1). Operation behaviours and consideration of wider literature were used to develop items. If behaviour or items could not be adapted from a previous scale, best practice in item design was followed [16].

Step 1.2. Rating Operational Behaviour Congruence of Instrument Items – Experts

Five experts reviewed the item pool for each domain and ranked on a 5-point scale (1 = strongly disagree, 5 = strongly agree) whether the item was focussed ('is the item directly related to the domain measured?') to each domain definition. All except one item achieved >80% consensus ('agree' or 'strongly agree') from experts that items were focused. The item that achieved a focus agreement of 60% was identified as a double-barrel statement, which made the item unclear. This was simplified and subsequently passed consensus. Expert recommendations for other items included modifications to language that improved readability, clarity, and brevity of the pool.

Phase 2: Think-Aloud Interviews – End Users

Community end users (five men with biopsy diagnosed prostate cancer who had undergone/begun treatment) participated in think aloud interviews. The think-aloud method is a cognitive interview approach that has theoretical and empirical support to reflect participant's cognitive processing when responding to surveys [17]. Following established procedures, participants read aloud each item and verbalised their thought processes immediately during response [18]. The interviewer probed with questions designed to elicit further interpretation and cognitive processing. After interviews, any item which was unclear, causing confusion, or interpreted differently from intention, were revised through an iterative process with think-aloud participants, and subsequently, research team members.

Participants reported that tested items were generally clear and understood due to their reference to everyday eHealth behaviours. Concerns were identified with: double-barrelled items; unintended responses due to perceived role in care; and, words which created confusion. Problematic items underwent adjustment and refinement. Research team members and experts reviewed the items to confirm content still reflected domains. Several items were dropped due to their similarity with other items of higher clarity. Interviews were ceased once saturation had been achieved, with lack of new insights. Final item mean readability was assessed with the Flesch–Kincaid Gradel Level algorithm, in view of general literacy of users [19].

Phase 3: P-CeHLI Assessment

Step 3.1 Field Testing – End Users

Participants were identified as part of the PrE-Health Study, a survey of Australian men with prostate cancer. The PrE-Health Study is aimed at understanding the digital information, technology, eHealth use, and eHealth literacy of men with prostate cancer. All participants were aged ≥18 years, spoke English, and had a biopsy confirmed diagnosis of prostate cancer that had undergone management (e.g., prostatectomy, radiotherapy, active surveillance, watchful waiting, androgen deprivation therapy, focal therapy, chemotherapy, etc).

A total of 396 participants were enrolled from three urology clinics across metropolitan and rural New South Wales, Australia. Surveys were delivered by e-mail or hard copy to reduce bias and capture a broad population with varying eHealth literacy levels. The survey included sociodemographic items, on-line health behaviour scales, psychometrics, quality of life scales, existing eHealth literacy measures, and a battery of items co-developed by eHealth experts and end users through Phases 1 and 2 of instrument development. The P-CeHLI items were tested twice, with a 3-month gap between each application of items. This was aimed to reduce consistency bias, memory and practice effect, considering both known and estimated literacy stability profiles. This investigation reports results relevant to P-CeHLI instrument development. Additional details of recruitment and survey methodology may be reviewed in our previous work [8]. In all, 347 participants completed the first survey relevant to instrument development, with 320 responding to repeat testing of the P-CeHLI (80.8% final response rate).

 © 2026 The Author(s). *BJU International* published by John Wiley & Sons Ltd on behalf of BJU International.

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Measures The TeHLI: the TeHLI includes 18 items anchored on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The instrument measures four subscale domain competencies: (1) functional; (2) communicative; (3) critical; and (4) translational. Higher subscale and total scores signify higher levels of eHealth literacy and domain specific ability [15]. The TeHLI has been validated against the eHEALS instrument and was used as a validation comparator considering the modern theoretical basis of our work.

Electronic Health use: informed by our previous investigations, participants were asked about digital information sources and technologies used in: (i) their general day-to-day lives (Yes/No); and (ii) to access prostate cancer information (Yes/No) [8]. This included information based websites (search engine, news website, health provider website, hospital website, government healthcare website, education/university website, cancer/charity website, pharmaceutical/device company website, medical/scientific journal website, on-line decision-aid website, or portal based website [log in and access personal information/results]); social media (Facebook, YouTube, Twitter, Instagram, LinkedIn, Pinterest, Reddit, TikTok, Snapchat, Wikipedia, community blogs, on-line support groups, Facebook Messenger, and WhatsApp); and digital technologies (computer, mobile phone browser, SMS/text messaging, tablet device browser, mobile and tablet applications, podcasts, e-mail, virtual and augmented reality, computer/video games, Quick Response (QR) barcode scanning, smart and wearable devices, and teleconference technology).

Digital expertise – participants were asked to report their level of expertise using technologies and digital information sources on a Likert scale, ranging between 1 (beginner), 2 (competent), and 3 (expert). This included use of: computers, mobile phones, the internet, phone/tablet applications, social media, and smart wearable devices.

Sociodemographics – participants reported age, relationship status (with partner, without partner), country of birth (Australia, overseas), education (primary/secondary school, university/vocational education), employment (working, retired), and government pension/disability support (yes, no). Income (<50 000, ≥50 000 Australian dollars [AUD]) was dichotomised on an approximation of the median personal yearly income detailed by the Australian Bureau of Statistics (ABS). Residence was dichotomised (major city, regional/remote) according to ABS Remoteness Structure (Australian Statistical Geography Standard [ASGS] Edition Three).

Statistical Analysis

Adequate sample size for this study was 300 participants according to guideline principles [14]. The field-tested P-CeHLI item pool initially consisted of 30 items. All analyses were conducted with Stata, version 18.0 (Stata Corp., College Station, TX, USA). Statistical significance was taken as $\alpha = 0.05$.

As scales were expected to follow a hypothesised structure, internal consistency was checked for scales constructed from the total item pool, followed by exploratory factor analysis (EFA) for dimensionality and confirmatory factor analysis (CFA) to test the hypothesised solution. Internal consistency reliability for each scale was assessed with Cronbach's α (resulted in dropping one of the items [see below]). Discriminant validity was assessed using Pearson's *r*. All correlation analyses were conducted with all available participants. The EFA, via a minimum residual approach, was completed on the first measure of the item sample, purely to assess the potential number of factors using scree plots and Horn's Parallel Analysis [20]. Next, we used the second measure of the sample for a CFA of remaining 29 items to test the hypothesised domain structure. The CFA used maximum likelihood estimation. Following standard practice, we assessed fit with the comparative fit index (CFI), the Tucker–Lewis index (TLI), the root mean square error of approximation (RMSEA), and the standardised root mean square residual (SRMR) [21–23].

To examine the relationship between respective TeHLi and P-CeHLI domains, scale scores were correlated. To evaluate construct validity of the P-CeHLI, we used ordinary least squares (OLS) regression models to compare the partial associations between the P-CeHLI scores and respondents' sociodemographic, self-reported technological expertise, cumulative indexes of general eHealth technology use, and prostate cancer-specific eHealth use (see Appendix S1 for P-CeHLI correlation of items in each index) and also for the equivalent relationship when controlling for the appropriate TeHLI scale, to demonstrate the additional predictive utility of the P-CeHLI for a prostate cancer population. For the cumulative indexes of technology use, whilst general eHealth produced a normally distributed index score that was amenable to OLS regression approaches, the prostate cancer-specific eHealth index showed strong zero-inflation (i.e., a substantial number of participants in the sample used no eHealth technologies specifically for prostate cancer) and this variable was recoded into an ordinal categorical with four levels (i.e., no usage, and low, moderate, and high usage) and general linear model analyses equivalent to partial correlations were conducted.

Results

Participants

The mean (SD, range) age was 69.6 (7.8, 36–88) years. Most participants were in a relationship with a partner (307

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

[88%]), born in Australia (267 [76.5%]), and lived in a major city (239 [68.5%]). Most participants had a university/vocational college level education (262 [75.1%]) and income ≥50 000 AUD (228 [73.1%]), with a lower level of government support (82 [23.7%]), and employment (157 [45%]) reported.

Item Analysis

Readability of final items according to the Flesch–Kincaid Grade Level algorithm, demonstrated an acceptable mean (SD) of 8.6 (2.4). The items, respective item-test correlations and alpha to remove (i.e., the value of alpha for that scale if that item were dropped), along with scale alphas, means, and SDs, are shown in Table 1. Overall scale alphas ranged from 0.85 to 0.96, placing them in the excellent range. At this point it was evident that Item 21, 'I can use internet connected devices (e.g. smartwatch, fitness tracker, pedometer) to maintain my health during cancer care', demonstrated poor item-test correlation of 0.5843 compared to the other items within the domain that were all >0.8 and was dropped prior to CFA.

Exploratory Factor Analysis-Dimensionality

We examined the sampling adequacy and correlation among the items for each tool before the EFA. The suitability for performing factor analysis was confirmed by examining Kaiser–Meyer–Olkin values for the datasets, which ranged from 0.9513 to 0.9736. Inspection of P-CeHLI scree and parallel analysis plots suggested that up to four factors (i.e., domains) were present in the data, matching the four domains of the TeHLI (i.e., functional, communicative, critical, and translational) and this was tested in the next phase.

Confirmatory Factor Analysis-Test of Fit

The four-factor model was submitted to a CFA on the responses of participants in the second, holdout subsample.

Table 1 Item analysis with scale mean (SD) and alpha to remove.

Domain and items	Mean (SD)	Item-test correlation	Alpha
Functional	3.42 (0.90)		0.85
I know how to find cancer information on the internet		0.76	0.82
I have the necessary skills to show someone how to find cancer information on the internet		0.82	0.81
I know how to join an on-line cancer support group if I want to		0.75	0.82
I know how to use the internet to understand words used by my cancer care team		0.80	0.81
I can use the internet to find transport to my cancer care appointments		0.66	0.84
I can find useful cancer information using social media		0.58	0.85
I know how to use internet connected devices (e.g., smartwatch, fitness tracker) to track my health and fitness (e.g., heartrate, sleep, steps, or workouts)		0.69	0.83
Communicative	2.93 (0.97)		0.91
I can identify when another user does not wish to talk during cancer conversations on the internet		0.76	0.90
I can talk on the internet about cancer topics with multiple users at the same time		0.86	0.88
I can participate in cancer conversations on the internet		0.86	0.88
I can identify the feelings or emotions expressed in cancer conversations on the internet		0.80	0.89
I can follow cancer conversations on the internet		0.83	0.89
I know how to make personal connections with other internet users who share cancer information		0.83	0.89
Critical	3.37 (1.01)		0.92
I can tell when cancer information on the internet is reliable		0.87	0.90
I can tell high quality from low quality cancer information on the internet		0.89	0.89
I can tell when information on the internet applies to my cancer care		0.85	0.90
I can identify when cancer information is written with commercial interests (e.g., by people trying to sell a product)		0.82	0.91
I can tell when an Internet user is a credible source of cancer information		0.89	0.89
Translational	3.28 (1.00)		0.96
I can use information from the internet to help me make an informed decision about my cancer treatment		0.82	0.96
I can use the internet to reduce anxiety about my cancer or cancer care		0.83	0.96
I can use the internet to learn strategies which I can use to improve my cancer related health and well-being		0.86	0.96
I can use information I find on the internet to help me with my cancer care		0.87	0.96
I can use the internet to reduce distress about my cancer or cancer care		0.85	0.96
I can use the internet to seek help when I have a problem caused by my cancer		0.82	0.96
I can use the internet to help me feel in control of my cancer care		0.88	0.96
I can use the internet as a tool to improve my cancer care		0.86	0.96
I can use the internet to reduce feelings of uncertainty about my cancer care		0.88	0.96
I can use cancer information on the internet to help make myself well		0.82	0.96
I can use information from the internet to make an informed decision about my cancer care		0.84	0.96

 © 2026 The Author(s). *BJU International* published by John Wiley & Sons Ltd on behalf of BJU International.

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Initial inspection of fit indices suggested the model showed good fit according to conventional criteria (Hu and Bentler [22]; Kline, [24]). Chi-square (371) = 1013.95, $P < 0.001$; RMSEA = 0.074 (lower bound of the 90% CI [LO90] = 0.068; upper bound of the 90% CI [HI90] = 0.079); CFI = 0.931; TLI = 0.924; SRMR = 0.051. No further modifications were undertaken to improve the marginal fit. No error variances were allowed to covary. As a check, the CFA was re-run on the first sample and equivalent results were: chi-square (371) = 1094.07, $P < 0.001$; RMSEA = 0.075 (LO90 = 0.070; HI90 = 0.080); CFI = 0.916; TLI = 0.908, suggesting acceptable fit. Factor loadings of P-CeHLI items may be found in Table S1.

Validity

First, Pearson correlations between the respective P-CeHLI and TeHLi domains were obtained and are shown in Table 2, along with correlations of all the subscales from both measures. This table shows strong and significant but not excessive correlations for functional, communicative, critical, and translational domains (r = 0.69, 73, 82, and 0.76, respectively), suggesting that the two measures are tapping into broadly similar domains.

Second, the P-CeHLI and TeHLI were compared with groups formed from the prostate cancer-specific index of eHealth use. This is shown in Table S2a. Inspection of these data show that for both the P-CeHLI and TeHLI, increasing prostate cancer-specific eHealth use was associated with increasing scale scores for all domains. Third, we examined correlation of the P-CeHLI and TeHLI domain scores with the cumulative index of general eHealth technology use (Table S2b). This demonstrated that for both measures, increasing general eHealth use was associated with increasing scale scores for all domains. Next, we examined self-reported digital expertise (Table S2c) and sociodemographic characteristics (Table S2d) of participants, showing similar results.

To address the question of whether the P-CeHLI could account for variance in usage when controlling for the TeHLI, partial correlations were calculated. These amounted to a strong test, given that the two measures were significantly correlated and would show whether the P-CeHLI was able to provide significant prediction after shared variance with the TeHLI is accounted for. As shown in Table 3, these analyses showed that for all four domains, P-CeHLI added predictive value even when controlling for respective TeHLI scores. For prostate-specific usage, a more complex strategy was required, as this was an ordinal categorical. A general linear model was conducted in each case entering the P-CeHLI domain scores and the respective TeHLI score and including three dummy variables representing the prostate-specific usage categories, where the no usage group represented the reference category. In each of case, the P-CeHLI again showed significant predictive value when controlling for respective TeHLI scores.

Discussion

Men with prostate cancer are an ageing, single-sex cancer cohort with complex care and decision needs [13]. Identifying individuals with limited eHealth literacy and enhancing their skills to navigate prostate cancer healthcare challenges may bolster their communication and decision-making capacities whilst providing opportunity to improve healthcare outcomes [25]. This work introduces the P-CeHLI, an instrument specifically designed and validated to assess eHealth literacy in men with prostate cancer. To the best of our understanding, it is the first tool that seeks to assess cancer-specific eHealth literacy. Moreover, it is a novel multidimensional assessment of eHealth literacy for men with prostate cancer that considers Web 2.0/3.0 progressions.

Based upon the theoretical underpinning of the TMeHL, the P-CeHLI allows us to describe a comprehensive picture of prostate cancer-specific eHealth literacy by measuring individual's functional, communicative, critical, and translational literacies. The EFA and CFA showed that all fit indices for our samples are within acceptable limits. The reliable and consistent results from the statistical validation thus showed that the P-CeHLI is a reliable and valid

Table 2 Correlations of respective scale domains.

Instrument and domain	TeHLI functional	TeHLI communicative	TeHLI critical	TeHLI translational	P-CeHLI functional	P-CeHLI communicative	P-CeHLI critical	P-CeHLI translational
TeHLI functional	1.0000							
TeHLI communicative	0.6986	1.0000						
TeHLI critical	0.6110	0.7426	1.0000					
TeHLI translational	0.7647	0.7411	0.7573	1.0000				
P-CeHLI functional	0.6929	0.7430	0.6781	0.7362	1.0000			
P-CeHLI communicative	0.5509	0.7305	0.6697	0.6414	0.8139	1.0000		
P-CeHLI critical	0.6080	0.6745	0.8162	0.7318	0.7187	0.7162	1.0000	
P-CeHLI translational	0.6046	0.7032	0.7081	0.7564	0.8092	0.7655	0.8007	1.0000

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Table 3 Correlation of general and prostate cancer-specific eHealth usage with P-CeHLI domain scores controlling for TeHLI scores.

Instrument	Functional	Communicative	Critical	Translational
Domain – General use of eHealth				
P-CeHLI	0.34***	0.14**	0.13*	0.22*
TeHLI	0.19***	0.31***	0.21***	0.25**
Domain – Prostate cancer-specific use of eHealth				
P-CeHLI	0.80***	0.70***	0.83***	0.86***

*$P < 0.05$; **$P < 0.01$; ***$P < 0.001$.

instrument to measure the eHealth literacy of men with prostate cancer.

Considering the theoretical underpinning of our work, the P-CeHLI was constructed to ensure comparability with the validated TeHLI. When we compared discriminant ability of the two scales regarding the prostate cancer-specific index of eHealth use, cumulative index of general eHealth technology use, self-reported digital expertise, and sociodemographic characteristics, we found similar associations. These results demonstrate that our scale has sensitivity to identify differences in eHealth literacy levels between these groups. Respondents with higher P-CeHLI scores across all domains were significantly more likely to demonstrate increasing prostate cancer-specific and general eHealth use, and to report higher levels of eHealth. The performance of the P-CeHLI in detecting social groups with variant eHealth literacy is an additional component to the validation of the scale. Broadly, participants with lower income or education, on government pension/disability support, who are not employed, and who live in regional/remote areas, were all more likely to have lower P-CeHLI scores across domains. This is consistent with prior work that suggests that these characteristics are associated with prostate cancer-specific eHealth technology engagement in men with prostate cancer [8].

We showed that the P-CeHLI performed better than the TeHLI in detecting the use of general eHealth technology in men with prostate cancer, as well as their prostate cancer-specific use of eHealth technology. The P-CeHLI provided significant prediction after shared variance with the TeHLI had been accounted for, supporting the role of P-CeHLI in the prostate cancer population, and more generally the use of context (i.e., cancer) specific psychometric instruments [26,27]. Considering these findings, and evidenced validity, we show that our goal to create a cancer-specific eHealth literacy instrument relevant to modern eHealth literacy theory (e.g., TMeHL) and the needs of patients with prostate cancer has been achieved. The P-CeHLI can thus be used to help evaluate the level of eHealth literacy of men with prostate cancer. Whilst our aim was to demonstrate this in a prostate cancer-specific context, the ability of the P-CeHLI to account for variance in both general eHealth technology use as well as prostate cancer-specific contexts suggests that the tool may be used to assess the eHealth literacy of men with prostate cancer across both.

The P-CeHLI can be completed as a stand-alone measure, or as part of larger survey batteries, helping to demonstrate sub-populations of men with prostate cancer who have inadequate eHealth literacy. From a research perspective, these data may be used to create targeted education strategies and interventions aimed at enhancing the eHealth literacy of men with prostate cancer. By measuring an individual's eHealth literacy before and after an intervention, we can quantitatively evaluate its effectiveness and inform future improvements to increase its impact [28]. In combination, the P-CeHLI may also be used to examine effects of eHealth literacy on clinical and psychological outcomes experienced by men with prostate cancer. By using the P-CeHLI in this way, researchers may strengthen the foundation of digital intervention research in prostate cancer, which to date, has lacked a modern and validated eHealth literacy tool for which to base design.

The P-CeHLI may be used by clinicians and health services to adapt information delivery or interventions to the needs of men with prostate cancer locally. This use of the P-CeHLI may facilitate improved patient self-management and engagement with health decision-making and care. Further research is necessary to demonstrate the efficacy of the P-CeHLI in this manner; however, existing research on interventions tailored to health literacy, numeracy or literacy of men with prostate cancer suggests positive impacts are likely [29]. As a result, the P-CeHLI may ultimately act as a catalyst for clinicians and researchers to improve informed and engaged decision-making of patients as part of their prostate cancer care.

Strengths of this work include its robust theoretical underpinning and methodology, inclusion of end users and expert stakeholders in instrument design and validation, a large survey population, digital and paper-based response pathways aimed to reduce bias and attrition, staged longitudinal design, and the development of a novel cancer-specific multidimensional instrument to assess eHealth literacy in prostate cancer populations. Despites this, our study has limitations. As the P-CeHLI is self-reported, reporting bias from respondents who under-/over-estimate

 © 2026 The Author(s). *BJU International* published by John Wiley & Sons Ltd on behalf of BJU International.

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

their abilities may occur. However, subjective assessment is the most suitable and resource mindful form of measurement for large population studies. Evidence is available that self-assessments accurately reflect health outcomes and literacy levels; however, results are mixed across the field, and the roles of objective and subjective eHealth literacy measures necessitate further research [30]. Second, the P-CeHLI represents only a selection of eHealth literacy skills that may be utilised by patients, which may render them incomplete or biased, whilst item groupings and formats may increase correlations. However, initial operational behaviours were grounded in TMeHL theory and developed from a breadth of literature that examined the use of eHealth technology/on-line information sources, eHealth literacy, and its measurement by existing eHealth literacy scales in men with prostate cancer. Finally, despite effort to include lower literacy populace, the proportion (75.1%) of participants in our cohort with vocational college/university level education was higher than available national data (e.g., Australian male aged 35–75-years rate of vocational/college qualification = 71.2%), which may affect generalisability to populations with lower educational attainment [31]. However, we note that this is a proportional improvement compared with the TeHLI, which had college (USA) level education for 82.3% of its testing population [16]. Whilst readability was addressed via phase 2 interviews and demonstrated acceptable Flesch–Kincaid Grade Level, construction of individual items may impact on individual user scores, dependent on general literacy skill level, cultural language comprehensions, and ability to read English.

Conclusion

This study demonstrated that the P-CeHLI is a reliable and valid instrument that can measure the eHealth literacy of men with prostate cancer. It is positioned to identify and respond to modern eHealth and communication needs of men with prostate cancer in the digital cancer care era, and in consideration of modern eHealth literacy communicative theory. The P-CeHLI provides an opportunity for clinicians and researchers to accurately identify and enhance the eHealth literacy skills of patients with prostate cancer, which may improve future clinical outcomes.

Funding

None.

Ethical Approval

University of Sydney Human Ethics Research Committee (project identifier: 2022/617).

Acknowledgement

Open access publishing facilitated by The University of Sydney, as part of the Wiley - The University of Sydney agreement via the Council of Australasian University Librarians

Disclosure of Interests

Nothing is declared.

References

1 **Prashar J, Schartau P, Murray E.** Supportive care needs of men with prostate cancer: a systematic review update. *Eur J Cancer Care (Engl)* 2022; 31: e13541
2 **Griebel L, Heidi E, Heidi G, Anna-Lena P, Julia M, Sedlmayr M.** eHealth literacy research—quo vadis? *Inform Health Soc Care* 2018; 43: 427–42
3 **Norman CD, Skinner HA.** eHealth literacy: essential skills for consumer health in a networked world. *J Med Internet Res* 2006; 8: e9
4 **Paige SR, Stellefson M, Krieger JL, Anderson-Lewis C, Cheong J, Stopka C.** Proposing a transactional model of eHealth literacy: concept analysis. *J Med Internet Res* 2018; 20: e10175
5 **Walsh MC, Trentham-Dietz A, Schroepfer TA et al.** Cancer information sources used by patients to inform and influence treatment decisions. *J Health Commun* 2010; 15: 445–63
6 **Jackson SR, Chambers S, Leslie S, Patel MI.** Prostate cancer, online health information and communication technology – bibliometric analysis of field with research frontiers. *Patient Educ Couns* 2023; 115: 107887
7 **Jackson SR, Yu P, Armany D et al.** eHealth literacy in prostate cancer: a systematic review. *Patient Educ Couns* 2024; 123: 108193
8 **Jackson SR, Yu P, Sowter S et al.** eHealth, digital information and technology use of men with prostate cancer. *Digit Health* 2025; 11: 20552076241309214
9 **Vasquez TS, Bylund CL, Alpert J et al.** Comparing transactional eHealth literacy of individuals with cancer and surrogate information seekers: mixed Methods study. *JMIR Form Res* 2022; 6: e36714
10 **Beckjord EB, Finney Rutten LJ, Arora NK, Moser R, Hesse BW.** Information processing and negative affect: evidence from the 2003 health information National Trends Survey. *Health Psychol* 2008; 27: 249–57
11 **Vrinten C, David B, Hing LS, Kobayashi LC, Christian vW, Waller J.** Does psychosocial stress exacerbate avoidant responses to cancer information in those who are afraid of cancer? A population-based survey among older adults in England. *Psychol Health* 2018; 33: 117–29
12 **Chae J, Chul-joo L, Jensen JD.** Correlates of cancer information overload: focusing on individual ability and motivation. *Health Commun* 2016; 31: 626–34
13 **Steginga SK, Occhipinti S.** The application of the heuristic-systematic processing model to treatment decision making about prostate cancer. *Med Decis Making* 2004; 24: 573–83
14 **Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL.** Best practices for developing and validating scales for health, social, and behavioral research: a primer. *Front Public Health* 2018; 6: 149
15 **Paige SR, Stellefson M, Krieger JL, Miller MD, Cheong J, Anderson-Lewis C.** Transactional eHealth literacy: developing and testing a multi-dimensional instrument. *J Health Commun* 2019; 24: 737–48
16 **Osterlind SJ.** *Constructing Test Items: multiple-Choice, Constructed-Response, Performance and Other Formats*, 2nd edn. United States of America: Kluwer Academic Publisher, 1998
17 **Charters E.** The use of think-aloud methods in qualitative research an introduction to think-aloud methods. *Brock Educ J* 2003; 12: 68–82.
18 **McGinnis D.** Text comprehension products and processes in young, young-old, and old-old adults. *J Gerontol B Psychol Sci Soc Sci* 2009; 64: 202–11
19 **Jindal P, MacDermid JC.** Assessing reading levels of health information: uses and limitations of Flesch formula. *Educ Health* 2017; 30: 84

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

20 **Horn JL**. A rationale and test for the number of factors in factor analysis. *Psychometrika* 1965; 30: 179–85
21 **Prudon P**. Confirmatory factor analysis as a tool in research using questionnaires: a Critique1,2. *Compr Psychol* 2015; 4: 03.CP.4.10
22 **Hu L**, **Bentler PM**. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Modeling* 1999; 6: 1–55
23 **Schermelleh-Engel K**, **Moosbrugger H**, **Müller H**. Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *Methods Psychol Res* 2003; 8: 23–74
24 **Kline, R. B.**. *Principles and Practice of Structural Equation Modeling*. New York, USA: Guildford Press, 2015.
25 **Xu RH**, **Zhou LM**, **Wong EL**, **Wang D**. The association between patients' eHealth literacy and satisfaction with shared decision-making and well-being: multicenter cross-sectional study. *J Med Internet Res* 2021; 23: e26721
26 **Dumenci L**, **Matsuyama R**, **Riddle DL et al.** Measurement of cancer health literacy and identification of patients with limited cancer health literacy. *J Health Commun* 2014; 19 Suppl 2: 205–24
27 **Krahn M**, **Bremner KE**, **Tomlinson G**, **Ritvo P**, **Irvine J**, **Naglie G**. Responsiveness of disease-specific and generic utility instruments in prostate cancer patients. *Qual Life Res* 2007; 16: 509–22
28 **Bender JL**, **Flora PK**, **Milosevic E et al.** Training prostate cancer survivors and caregivers to be peer navigators: a blended online/in-person competency-based training program. *Support Care Cancer* 2021; 29: 1235–44
29 **Kripalani S**, **Sharma J**, **Justice E et al.** Low-literacy interventions to promote discussion of prostate cancer: a randomized controlled trial. *Am J Prev Med* 2007; 33: 83–90
30 **Schulz PJ**, **Pessina A**, **Hartung U**, **Petrocchi S**. Effects of objective and subjective health literacy on patients' accurate judgment of health information and decision-making ability: survey study. *J Med Internet Res* 2021; 23: e20457
31 **Australian Bureau of Statistics**. *Education and Work, Australia*. Canberra: ABS, 2025. https://www.abs.gov.au/statistics/people/education/education-and-work-australia/may-2025

Correspondence: Stuart Robert Jackson, University of Sydney, Port Macquarie, New South Wales, Australia.
e-mail: sjac8394@uni.sydney.edu.au

Abbreviations: ABS, Australian Bureau of Statistics; AUD, Australian dollars; CFA, confirmatory factor analysis; CFI, comparative fit index; EFA, exploratory factor analysis; eHEALS, eHealth Literacy Scale; eHealth, electronic health; HI90, upper bound of the 90% CI; LO90, lower bound of the 90% CI; OLS, ordinary least squares; P-CeHLI, Prostate Cancer eHealth Literacy Instrument; TeHLI, Transactional eHealth Literacy Instrument; TLI, Tucker–Lewis index; TMeHL, Transactional Model of eHealth Literacy; RMSEA, the root mean square error of approximation; SRMR, standardised root mean square residual.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Fig. S1. Operational behaviours.

Appendix S1. General and prostate cancer-specific usage of eHealth P-CeHLI.

Table S1. Item factor loadings of the P-CeHLI.

Table S2a. Correlation of prostate cancer-specific index of eHealth use with instrument domains.

Table S2b. Correlation of cumulative index of general eHealth technology use with instrument domains.

Table S2c. Self-reported eHealth expertise by P-CeHLI domain.

Table S2d. Analyses to examine relationship between P-CeHLI scores and sociodemographic variables.
a = correlation; b = mean difference; $*P < 0.05$; $**P < 0.01$; $***P < 0.001$ (Country of birth: Australia = 1, Overseas = 2; Relationship status: With partner = 1, Without partner = 2; Government pension/disability support: Yes = 1, No = 2; Income: <50 000 AUD = 1, ≥50 000 AUD = 2; Employment: Working = 1, Retired = 2; Residence: Major city = 1, Rural/regional = 2; Education: University/vocational = 1, Primary/secondary School = 2).

 © 2026 The Author(s). *BJU International* published by John Wiley & Sons Ltd on behalf of BJU International.

1464410x, 2026, S2, Downloaded from https://bjui-journals.onlinelibrary.wiley.com/doi/10.1111/bju.70225 by University Of Technology Sydney, Wiley Online Library on [08/10/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License