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A scoping review on nursing interventions for pain and sleep management in cancer patients receiving immunotherapy: revealing critical gaps in sleep disturbance assessment

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Abstract

Background

Immunotherapy has transformed cancer management. Patients receiving immune checkpoint inhibitors frequently experience concurrent pain and sleep disturbances that affect quality of life, treatment adherence, and overall survival. Nursing interventions addressing both symptoms remain poorly defined.

Methods

This scoping review searched the Scopus, ScienceDirect, PubMed, and CINAHL for *updates from 2019 to 2025* following PRISMA-ScR guidelines; ten studies were included (randomized controlled trials, systematic reviews, and observational studies for all cancers.

Results

Nurse-led interventions included education, physical therapies (massage, reflexology, acupressure), behavioral approaches, and digital platforms (telehealth, electronic patient-reported outcomes). The patients achieved moderate short-term pain reductions, significantly improved quality of life, enhanced treatment adherence, and reduced emergency department visits by up to 45%. However, only 2/10 studies used validated instruments to measure sleep quality, and *none* designed primary interventions specifically targeting sleep disturbances in immunotherapy patients. Long-term sustainability of pain interventions was questionable, with most effects attenuating beyond eight weeks except for psycho-educational approaches.

Conclusion

Future research should develop integrated, nurse-delivered interventions addressing pain and sleep as interconnected symptoms, with extended follow-up periods and enhanced accessibility across diverse healthcare settings. Validated instruments to measure sleep quality should be employed.

Introduction

Cancer pain affects approximately 60% of patients with advanced malignancy, with nearly 20% experiencing moderate to severe pain that significantly impacts their quality of life and treatment adherence [1]. Sleep disturbances present an equally significant burden, particularly in patients receiving immune checkpoint inhibitors (ICIs), a revolutionary cancer immunotherapy approved since 2011 that reinvigorates the host immune system to combat tumor cells, including melanoma [2]. Recent evidence indicates that 51.9% of ICI treated patients experience clinically relevant sleep disturbances, and the mean Pittsburgh sleep quality index (PSQI) Score was 7.54 ± 5.39), with sleep disturbances prevalence in the broader cancer population ranging from 25% to 59% [3,4].

The clinical significance of these symptoms extends beyond patient comfort. Sleep disturbances are independent predictors of worse progression-free and overall survival rates in cancer patients on ICI including melanoma [5], being potentially mediated by elevated proinflammatory cytokines, such as interleukins and tumor necrosis factor (IL-1, IL-6, TNF-α) that regulate sleep wake homeostasis and promote tumor progression [3]. Independent predictors of sleep disturbances included Eastern Cooperative Oncology Group (ECOG) performance status ≥1 (Odds ratio (OR) 2.33,

P=0.015), second line therapy or beyond (OR 2.43, p=0.021), and ≥2 metastasis sites (OR 2.10, p= 0.021) [3], similarly, inadequate pain management not only increases suffering but compromises treatment effectiveness [1].

Nursing interventions for cancer pain *by itself* have been extensively studied, with a comprehensive scoping review identifying 22 types of nursing support from 72 studies [1]. Education programs constitute the most researched intervention (31 studies), followed by physical interventions (massage, reflexology, exercises), cognitive behavior approaches, and comfort nursing strategies that integrate physiologic, psychologic, and social dimension [6]. However, a critical gap exist: while nursing interventions demonstrate short-term effectiveness, long-term sustainability remains controversial and unproven [7]. More importantly, no integrated approaches addressing both pain and sleep *simultaneously in ICI-treated patients* has been designed, despite their shared inflammatory mechanisms [3] and high co-prevalence in this population [1,4].

Current patient-reported outcome (PRO) instruments inadequately capture ICI-specific symptoms, with 29% of adverse events remaining uncovered/unaddressed [4]. Instruments used to report PRO symptom-related toxicities covered 45% of the most frequently reported AEs, whereas 23% of AEs were partially covered and 29% were not covered at all. Of non-covered AEs, 59% referred to the dermatologic system. Partially covered AEs related to endocrine and specific types of pain [4]. *These symptoms may be caused or enhanced by ICIs.* Innovative technology-based approaches, such as the cancer pain monitoring system (CAPAMOS), have shown promise in reducing symptoms and emergency visits [8]; however, their application to integrated pain sleep management in ICI remains unexplored. Furthermore, while specialized oncology nurses effectively manage ICI toxicities through education, symptoms monitoring and evidence-based triage tools [9], interventions for *community and non-specialized healthcare settings* remain underdeveloped.

Aim

This scoping review aimed to *update* nursing interventions for cancer pain management in patients receiving immunotherapy and to examine to what extent sleep quality has been assessed or targeted by these interventions for cancer patients. The *primary objective* is to identify effective strategies for management. The *secondary objectives* are to characterize technology-based approaches, examine integrated symptom management models, and highlight gaps requiring future investigation.

Materials and Methods

Study design

This scoping review was conducted and reported in accordance with the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews) guidelines [10].The *research question* is: ”What are the effective nursing interventions for pain and sleep management in cancer patients on immunotherapy?”

Search strategy

A comprehensive search was conducted across four major electronic databases: Scopus, ScienceDirect, MEDLINE/PubMed, and CINHAL (Cumulated Index to Nursing and Allied Health Literature). It utilized a combination of keywords, including ("nursing intervention" OR "nurse-led" OR "oncology nursing" OR "nursing care") AND ("cancer" OR "neoplasm " OR "malignancy" OR "tumor") AND ("immunotherapy" OR "immune checkpoint inhibitor " OR "cancer treatment") AND ("pain" OR "sleep quality" OR "sleep disturbance" OR "symptom management"). The search started from 1 January 2019 to 30 November 2025, as the team is interested in updated literature so this manuscript can be more focused and concise. This is also the typical time span that a scoping review is generally performed. We used the Preferred Reporting Items for Systematic Reviews and Meta-analyses extension for Scoping Reviews (PRISMA-ScR)

methodology. It does not require study protocols to be prospectively registered. As a scoping review, our methodological objective differs from that of a systematic review. According to the PRISMA-ScR guidelines, scoping reviews aim to map the breadth and nature of existing evidence across heterogeneous study designs, including both primary research and the secondary literature. The search included all cancers to ensure generalizability and to give enough results. The checklist and search strings are in Table S1 and S2.

Inclusion and exclusion criteria

Inclusion criteria are: quantitative, qualitative, or mixed methods research on cancer patients receiving ICI therapy or studies whose findings are applicable to patients on immunotherapy; nursing interventions for pain and/or sleep management; reported outcomes on pain intensity, pain control, sleep quality, or related to PROs published in English between January 2019 to November 2025. Exclusion criteria are: unrelated to nursing interventions or not meeting inclusion criteria.

Given that preliminary searches focusing exclusively on ICI-specific patients yielded insufficient studies for a comprehensive scoping review, we adopted a pragmatic approach by including (1) studies specifically conducted in ICI-treated cancer populations AND (2) studies in general cancer populations where nursing interventions were feasible for adaptation to immunotherapy settings based on:

- Mechanism of action (symptom management principles)

- Nursing delivery models (education, physical therapies, technology-based)

- Symptom overlap between general cancer and ICI populations.

Of the 10 included studies [9,11-19], 4 (40%) were ICI-specific [9,12,13,18], while 6 (60%) examined general cancer populations with interventions deemed transferable to ICI contexts [11,14,15-17,19]. No minimum follow-up duration was specified in the inclusion criteria, as this scoping review aimed to map the breadth of available evidence, regardless of study duration. However, follow-up periods were systematically extracted and documented to assess the existing evidence base for the long-term sustainability of nursing. Two authors (O.A. and P.T.) independently reviewed eligible study title and abstracts in screening, followed by full-text assessment. Any discrepancies or disagreements were resolved through discussion and re-examination of the articles. A third researcher (E.Y.) was available to arbitrate if consensus could not be reached.

Risk of bias assessment tool

Two independent reviewers (O.A. and P.T.) extracted data using a standardized form, with discrepancies resolved through discussion with a third reviewer (E.Y.) if necessary. Due to the heterogeneous nature of the included studies (randomized controlled trials, systematic reviews, and observational studies with varying methodologies), a formal quality assessment was *not necessary* for scoping review; however, study characteristics including design type, sample size, and outcome measures had been carefully checked during the study.

The purpose of this review was to map the breadth of available evidence rather than to assess the quality of individual studies for meta-analysis. Data were synthesized descriptively to categorize interventions and summarize their impact on patient outcomes.

Data collection

Data extraction was conducted using a standardized form to capture study characteristics (author, year, country, population, disease stage), nursing intervention types and components, study design and setting, sample size, clinical

and patient-reported outcomes.

Results

Characteristics of selected studies

The systematic search across PubMed/MEDLINE, Scopus, ScienceDirect, and CINAHL databases yielded 485 records. After removal of duplicated titles and checking abstracts and full tests, 10 studies were included in the final review **(Figure 1).** These comprised two randomized controlled trials (RCTs) [11,12], four systematic reviews and meta-analyses [13,14,15,16], and four observational studies [9,17,18,19](**Table 1**). Studies were conducted across multiple countries: five from China [11,12,16,17,19], one from Denmark [18], one from Canada [14], one from South Korea [15] and two multi-country collaborations [9,13]. The combined sample included approximately *4,300+* patients from primary studies and 55+ patients from RCTs and systematic reviews [13-16]. Cancer types varied, with melanoma [13,18] being one of the most common pathologies.

Table1 showed the characteristics of the ten selected studies.

Table 1. Characteristics of the ten selected studies

Authors/ years	Country	Study design	Settings	Cancer type	Sample size	Age (years)	ICIs used
Tolstrup [18]	Denmark	Mixed methods RCT	University hospital	Metastatic *melanoma*	N= 70 (57 surveyed)	Median 65	Immunotherapy
Hall [13]	USA/multi country	Systematic review	Multi center trails	*Melanoma,* lung, GU, H&N	15 RCTs	44.1-67.3	Nivolumab, pembrolizumab
Zhang [12]	China	RCT	28 Tertiary hospitals	Gastric, esophageal, lung	N=278 (141 int.)	58.8 ±12.7	Multiple ICIs
Mirzadeh [9]	Canada	Perspective	Clinical practices	All ICI candidates	Review	Not specific	PD-1/PD-L/CTLA-4
Yan [16]	China	Systematic review	Multiple databases	Various cancer types	1,070 (17 RCTs)	Not specific	Various (review)
Kwok [14]	Multiple countries	Systematic review	Multiple settings	Various cancer types	2,315 (10 studies)	Variable means	Various (review)
Liu [17]	China	Retrospective cohort	Hubei cancer hospital	Lung cancer (stage II-IV)	N = 291 (137 int.)	65.1±7.9 vs 65.5±8.4	Chemo, targeted, immune
Bu [19]	China	Longitudinal study	Tertiary hospital	Hepatocellular carcinoma	N = 130	46-69 (66.2%)	Immune+ targeted+ interventions
Li [11]	China	Retrospective observational	2 tertiary hospitals	Colorectal cancer	N = 100 (50 int.)	Not specified	Adjuvant / Chemotherapy
Park [15]	South Korea	Systematic review	Multiple databases	Various cancer type	22 RCTs	44.1-67.3	Music, physical, psycho-educational

CTLA-4: cytotoxic T-lymphocyte-associated protein 4, **CRC**: colorectal cancer, **GU:** genitourinary, **H&N:** head and neck, **HCC:** hepatocellular carcinoma, **ICI:** immune checkpoint inhibitor, **PD-1**: programmed cell death protein 1**, PD-L1**: programmed death-ligand 1, **int.:** interventions group, **N**: sample size, **RCT:** randomized controlled trial, **USA:** united states of America, **vs:** versus.

Nursing intervention types and components

Thematic analysis identified categories of nursing interventions: educational, physical, cognitive-behavioral, integrated symptoms management, and technology-based approaches. Intervention characteristics are detailed in Table 2.

Table 2: Intervention details and populations

Study	Cancer stage	Intervention type	Key components	Duration	Delivery methods
Tolstrup [18]	Metastatic	eHealth PRO weekly	Weekly PRO-CTCAE symptoms reporting via tablet from home	Weekly during treatment	eHealth platform (home-based)
Hall [13]	Unresectable/metastatic (n=13), adjuvant (n=2)	PRO measurement	Systemic review of 15 ICI trials with PRO data	Various	Various clinical trial questionnaires
Zhang [12]	Mixed cancer types	ePRO follow up model with alerts	Questionnaire + image recognition for irAE grading; automated advice for grades 1-2; alert for grades 3-4	6 months or until treatment ends	Mobile app/ web-based + image recognition
Mirzadeh [9]	Various stages	Nursing education, assessment, monitoring	Patient education (multiple formats), symptoms assessment, nurse-led clinics, support services	Ongoing throughout treatment	In-person, telephone, video, written materials
Yan [16]	Various (systematic review)	Non-pharmacological pain management	Reflexology, aromatherapy, acupressure, massage therapy, acupuncture.	Varied (1990-2023)	In-person therapy sessions
Kwok [14]	Various	Nurse-led telehealth	Telephone calls, video consultations, web-based systems, SMS, mobile apps (reactive/scheduled)	≥ 4 weeks minimum	Telephone, video, web SMS, mobile applications
Liu [17]	Stage II-IV (72.3% stages III-IV)	Personalized nursing care	20-30 minutes baseline consultation + telephone/video follow-ups on days 4 & 10 of each cycle	8 weeks post-treatment initiation	Telephone & video consultations
Bu [19]	Advanced stage	Symptom self-report questionnaires	Symptoms assessment at weeks 1,2,3 using standardized scales	3 weeks post intervention	Paper-based questionnaires (in-person)
Li [11]	Various	Pain education nursing with mind mapping	Nurses used mind map to guide pain education and perioperative care planning	Perioperative and postoperative	Repeated in-person education sessions
Park [15]	Various (systematic review)	Nurse-led Non pharmacological interventions	Music interventions, physical exercises, psycho-educational programs	Various timeframes	Various (nursing delivered)

CRC: colorectal cancer, **eHealth:** electronic health, **ePRO:** electronic patients reported outcome**, HCC:** hepatocellular carcinoma, **ICI:** immune checkpoint inhibitor, **irAE:** immune related adverse event, **PRO**: patients-reported outcome, **PRO-CTCAE**: patients reported outcomes version of the common terminology criteria for adverse events**, SMS:** short message service.

Educational interventions

Six studies examined education interventions delivered by oncology nurses [9,11,13-15,17]. Individualized 20–30-minute consultations incorporated baseline quality of life screening, symptom anticipation counseling, and personalized care planning [17].

Mind mapping is a combination of images and logical thinking in the form of pictures and text. It was used as structured teaching tool to present pain education and perioperative care precautions [11]. Nurses created and used it to structure pain-education content. Mind maps visually organize:

- Pain mechanisms
- Expected postoperative pain trajectory
- Analgesic options
- Non-pharmacological pain strategies
- Self-management steps

Psycho-educational interventions achieved medium short-term effect sizes for pain reduction (Hedge's=0.43, P□0.001) and significant improvements in pain management knowledge (g=0.91, P□0.001)[15]. Long-term effects were small but significant (g=0.25, P=0.022), though sustainability remained controversial [15].

Physical interventions

A systematic review of 17 RCTs evaluated physical non pharmacological [16]. Massage therapy showed a standardized mean difference (SMD) of −1.0 (95% CI: −1.08 to −0.92; P<0.001) with high heterogeneity (I^2=88%)[16]. Reflexology, aromatherapy and acupressure also significantly reduced cancer related pain (all P□0.001)[16]. Physical interventions achieved medium short term effect sizes (g=0.47) but only small non-significant long-term effects (g= 0.16)[15].

Cognitive-behavioral and integrated interventions

Personalized nursing programs combining symptom assessment, psychological support, and lifestyle counseling results in significantly greater quality of life improvements (Δ+ 13.2 ± 7.6 vs + 5.1 ± 6.8, P□0.001)[17]. Treatment adherence improved (91.2% vs 78.6%, P=0.006) with fewer unplanned healthcare visits (12.4% vs 23.4%, P=0.014)[17]. Weekly symptom self-reported questionnaires tracking 16 symptoms over three weeks revealed pain prevalence decreased from 73.8% to 48.5% (34.3% reduction), while insomnia decreased from 53.1% to 44.6% (16.0% reduction) [19].

Technology based approaches

An eHealth PRO monitoring system using tablet-based PRO version of the common terminology criteria for adverse events (PRO-CTCAE) achieved 100% patient satisfaction with ≥90% agreement on tool usefulness [18]. However; 30-40% of patients expressed concerns about lack of clinician review [18]. An ePRO follow up model with automated alerts demonstrated significant benefits: serous immune related adverse effects (irAEs) occurred in 20.6% vs 33.6% (Hazard ratio or HR=0.51, P=0.01), emergency department (ED) visits were 16.3 % vs 29.9% (HR=0.46, P=0.01), and treatment discontinuations was 3.6% vs 11.0% (HR=0.30, P=0.02)[12]. Telehealth interventions significantly reduced pain severity (SMD -0.54, P□0.05) but showed no significant differences in hospitalizations [14].

Outcomes and effectiveness

Table 3 shows recent studies in past 7 years. Nursing-led non pharmacological interventions demonstrated moderate short term effect sizes for pain reduction (g=0.39; 95 % CI: 0.25-0.52; P□0.001) across 22 studies [15]. Long-term pain effects were substantially diminished (g= 0.10;95% CI: -0.05 – 0.26; P=0.187), except for psycho-educational

interventions which maintained small but significant effects (g=0.25, P=0.022)[15]. All five physical intervention modalities significantly reduced cancer pain (P□0.001), with acupuncture showing the largest effect (SMD -2.09) and massage showing the most consistent results (I2=0%)[16]. Visual analog scale pain scores were significantly lower in pain-education nursing groups (P□0.05), with ≥40% pain reduction achieved [11]. There are many practical difficulties that nurses encounter in pain management [20,21]. Researchers are continually trying to resolve them by improving the knowledge of the nurses and these should be included in the nursing training curriculum and continuous professional development after graduation [22].

Primary outcomes and key findings in updates of pat 7 years is detailed in table 3.

Table 3: Primary outcomes and key findings in updates of past 7 years.

Study	Instruments used	Primary outcomes	Future recommendations
Tolstrup [18]	Patients feedback form (13 items), interviews, focus group	Patient/clinician satisfaction, symptom awareness, patient involvement	Standardize PRO measurement; improve clinician-patients communication tracking; multicenter validation
Hall [13]	EORTC QLQ-C30 (80%), EQ-5D (67%), FKSI-DRS, LCSS, EORTC QLQ -H&N35	HRQoL with ICIs vs other therapies	Develop ICI-specific PRO instruments; harmonize outcomes measurement; long-term HRQoL tracking
Zhang [12]	PRO-based QoL questionnaire, EORTC QLQ-C30	Serious irAEs (Grades 3-4), ED visits, QoL, treatment discontinuation	Large-scale RCTs in diverse populations; cost effectiveness studies; digital literacy interventions
Mirzadeh [9]	Risk assessment tools, educational frameworks	Early detection of irAEs, patients' educations effectiveness	Multi-setting evaluation of nursing roles; systematic protocols for early detection; international collaboration
Yan [16]	BPI, NRS, VAS	Cancer-related pain reduction	Standardized intervention protocols; dose-response studies; combination therapy trails; 6–12-month outcomes
Kwok [14]	EORTC QLQ-C30, EQ-5D, various symptom scales	Health services use, QoL, symptom severity	More nurse-led telehealth RCTs; consistent outcomes measurement; reactive vs scheduled comparison; cost-effectiveness
Liu [17]	EORTC QLQ-C30, HADS, STAI	Overall QoL improvement at 8 weeks	Multicenter RCTs with extended follow-up; diverse populations; cost-benefit analysis; mechanistic studies
Bu [19]	Symptom assessment scale (Likert 0-6)	Dynamic symptom changes over 3 weeks	Extended longitudinal studies; larger sample sizes; earlier intervention (pre-treatment); trajectory modeling
Li [11]	VAS (pain), SAS/SDS (anxiety/depression), EORTC QLQ-C30	Postoperative pain, QoL, emotional distress, comfort	Multicenter trials; long-term follow-up; blinded design; economic evaluation; adaptability to different settings
Park [15]	Various pain measure, HRQoL instruments	Pain reduction, knowledge of pain management, pain coping	Standardized intervention protocols; optimal dosing guidelines; mechanism studies; patient-centered outcomes

BPI: brief pain inventory, **ED:** emergency department, **EORTC QLQ-C30:** European organization for research and treatment of cancer quality of life questionnaire-Core 30, **EORTC QLQ-H&N35**: European organization for research and treatment of cancer quality of life questionnaire-head and neck 35, **EQ-5D:** Euro-QoL5-dimension questionnaire, **FKSI-DRS:** functional

assessment of cancer therapy -kidney symptom index-disease related symptoms, **HADS:** hospital anxiety and depression scale, **HRQoL:** health-related quality of life, **irAEs:** Immune related adverse events, **ICI:** immune checkpoint inhibitor, **LCSS:** lung cancer symptom scale, **NRS :**numeric rating scale, **PRO:** patients reported outcome, **QoL:** quality of life**, RCT**: randomized controlled trial, **SAS**: self-rating anxiety scale, **SDS:** self-rating depression scale, **STAI**: state-trait anxiety inventory**, VAS:** visual analog scale.

For sleep quality, critical evidence gap identified: only 2 of 10 studies explicitly measured sleep quality using validated instruments [17,19]. Sleep disturbances affect 51.9% of ICI-treated patients (mean PSQI score: 7.54±5.39), with independent predictors including ECOG performance status ≥1 (Odds ratio (OR) 2.33, P=0.015), second-line or beyond therapy (OR 2.43, P=0.015), and ≥2 metastasis sites (OR 2.10, P= 0.021)[19]. Sleep disturbances independently predict worse progression free and overall survival in ICI recipients [19]. Insomnia prevalence decreased from 53.1% (week 1) to 44.6% (week 3) in one longitudinal study, representing 16% improvement [19]. No studies designed primary interventions targeting sleep disturbances in ICI treated populations, representing a substantial evidence gap [19].

While our study focused on immunotherapy patients, sleep disturbances and pain have been studied in the general cancer population—with established interventions such as cognitive behavioral therapy for insomnia (CBT-I) demonstrating large effect sizes, and comprehensive symptom-cluster research available across multiple cancer types [23,24]. Ye, et al from China reported 365 patients who completed questionnaires: symptom cluster class 1 ("low symptom burden" class), class 2 ("fatigue-insomnia" class), and class 3 ("high symptom burden" class), with a percentage of 54.5%, 38.6%, and 6.8%, respectively [23]. The quality-of-life score, introversion/extroversion, economic burden, Karnofsky Performance Status, albumin level, and exercise self-efficacy were significantly different among the 3 classes (P<0.05). They concluded that exercise self-efficacy is important for personalized interventions and improving symptom management efficiency [23]. In United States, intervention also helps with sleep quality and negative emotions [25].

Patients receiving ICIs present unique characteristics. Unlike those undergoing traditional chemotherapy, individuals treated with ICIs exhibit sleep disturbances that are independent predictors of progression-free and overall survival [19](Bu et al., 2025). These disturbances are mediated through elevations in pro-inflammatory cytokines (IL-1, IL-6, TNF-α), which simultaneously regulate sleep–wake homeostasis and promote tumor progression [19,26]. This intricate relationship between immunity, sleep, and the tumor microenvironment is distinct to immunotherapy [27] and varies based on cancer type and pre-existing patient factors. Furthermore, circadian rhythm disruptions in immunotherapy patients may offer unique opportunities to optimize treatment outcomes, as sleep quality directly influences immune checkpoint inhibitor efficacy [28]. Given the promising improvements in cancer outcomes with ICIs and the high prevalence of sleep disturbances (51.9%) in this population [19], these knowledge gaps regarding integrated sleep and pain management should not be ignored. Addressing circadian rhythm disturbances and sleep quality may provide novel strategies to enhance immunotherapy efficacy, reduce symptom burden, and improve quality of life in this specific and vulnerable population.

Quality of life and patient satisfaction

Personalized nursing interventions demonstrated comprehensive QoL benefits: overall QoL scores improved +13.2 ± 7.6 points in intervention vs +5.1 ± 6.8 in control (P□0.001), representing 158% greater improvement [17]. Physical, emotional, cognitive, and social functioning all significantly improved (P□0.01). Patient satisfaction with eHealth PRO platforms was 100% with ≥90% agreements on ease of use [18]. Two of three reactive telehealth studies reported improved quality of life, and all telehealth interventions showed reduction in symptom severity [14].

Health services utilization

Emergency department visits were reduced by 45% (16.3% vs 29.9%, HR 0.46, P=0.01) with ePRO monitoring [12]. Treatment discontinuation was reduced by 67 % (3.6% vs 11.0%, HR 0.30, P = 0.02)[12]. Mean follow up time was reduced by 77% (8.2 ±3.9 vs 36.1 ±15.3 minutes, P□0.001)[12]. However, no statistically significant differences in hospitalizations or unscheduled clinic visits were found between nurse led telehealth and usual care groups [12].

Implementation factors and future research

Specialized oncology nurses effectively manage ICI toxicities for different types of cancer through evidence-based education, systematic assessment, nurse led clinics, and specialized triage protocols, though efficacy in community settings remains underdeveloped [9]. Digital literacy disparities were identified as a primary limitation, with 7.3% eligible patients excluded due to inability to use smartphones or computers [12]. Inadequate integration of PRO data into clinical workflows was another limiting factor [18]. Single-center study designs may limit generalizability to lower resource settings [17].

Only 2 of 10 studies measured sleep quality [17,19]. Most studies had follow-up duration of ≤8 weeks, with only one achieving 6 months [14,17,19]. Nursing interventions demonstrated short-term effectiveness but long-term sustainability remains controversial [15]. Current PRO instruments inadequately capture ICI specific symptoms with 29% of adverse events remaining unaddressed, 50% of studies were conducted in China with limited representation from low resources settings and community healthcare environment [11,12,16,17,19].

This scoping review focuses on ICIs. There are other useful studies in general in the literature as well, e.g. the pain-sleep symptom cluster [29,30], massage therapy [31] and other non-pharmacological methods for insomnia [32,33]. Studies on chemotherapy in the past may also guide future immunotherapy research [34,35], which also linked perturbations in immune-inflammatory pathways by chemotherapy with insomnia among cancer patients [36].

Discussion

The Current Situation

ICI is increasingly used in treatment for various cancers []. It is interesting to know how the treatment of pain and insomnia caused or aggravated by ICI was reported in the literature globally. The present report provides a concise summary of the global view, with useful updated references for healthcare providers of different disciplines. Similar analogy can be applied to other cluster symptoms such as anxiety and depression, and in different countries []. In fact, androgen deprivation therapy or chemotherapy can also be associated with symptom clusters [].

An illustrative case in Canada involves a 76-year-old man who experienced severe pain from a right femoral metastasis of melanoma despite receiving ICI. The pain was so severe that he could not sleep for several days. The patient was instructed to adjust his morphine over the weekend by a healthcare provider phoning him twice a day to monitor his response. An anti-emetic, stool-softener and laxative were also prescribed, to decrease his side effects from morphine which were not dealt with by his family doctor. His pain lessened and he finally got a good sleep on Sunday. In the following week, a single-fraction radiotherapy was given. His quality of life was maintained for 4 months before dying of the cancer. The learning points were:

- The timely dedicated care can be offered by a nurse practitioner, member of the palliative care team (nurse or physician), family doctor, oncologist in the Canadian healthcare system. This highlights the importance of early palliative care referral, which should have been arranged by his rural family doctor at the same time of referral to the oncology service.
- How can we work smarter and save healthcare dollars at the same time?

- Local pain can be effectively dealt with by a single dose of radiotherapy, which is very convenient to patients living remotely from cancer centers [,]. Rapid access clinics with same day volumetric modulated arc therapy is safe and accessible.

What nurse-led interventions may achieve?

Only 2 of 10 studies measured sleep quality [17,19] in the past 7 years. Insomnia improved modestly (53.1% to 44.6%) as part of comprehensive nursing care [19]. This research gap is particularly concerning given shared inflammatory mechanisms (IL-1, IL-6, TNF-α) linking sleep, pain, and tumor progression [19]. Current PRO instruments inadequately capture ICI-specific symptoms, with 29% of adverse events unaddressed [13], likely contributing to under recognition of sleep disturbances.

Personalized nursing programs combining symptom assessment, psychological support, and lifestyle counseling achieved 158% greater quality of life improvement than usual care (+ 13.2% vs + 5.1%, P < 0.001)[17,], with significant improvements across physical, emotional, cognitive, and social functioning. Treatment adherence improved (91.2% vs 78.6%, P = 0.006) and unplanned healthcare visits decreased (12.4% vs 23.4%, P = 0.014)[17], demonstrating that comprehensive nursing support enables effective home-based symptom management.

Nurse-led non-pharmacological interventions demonstrated moderate short-term effectiveness for pain reduction (g = 0.39, P□0.001) across diverse modalities [15]. Physical interventions, particularly massage therapy and reflexology, showed robust immediate effects, consistent with previous meta-analyses reporting significant pain relief with complementary therapies in oncology populations [16]. Aromatherapy is also very useful []. However, the substantial attenuation of long-term effects (g = 0.10, P = 0.187) except for psycho-educational interventions underscores a critical limitation: most interventions lack sustainable impact beyond the active treatment period. Educational interventions achieved notable improvements in pain management knowledge (g = 0.25, *P* = 0.002), suggesting that patient empowerment through education may facilitate sustained self-management [15]. The use of structured teaching tools such as mind mapping aligns with adult learning principle emphasizing visual and organizational strategies to enhance retention. These findings support the integration of multi-modal educational approaches tailored to individual patient's needs, particularly given complex and evolving symptom profiles associated with ICI.

How new technologies may transform healthcare?

Electronic patient reported outcome (ePRO) systems demonstrated significant improvements in safety outcomes, reducing serious immune-related adverse events by 39% (HR 0.51, P = 0.01), emergency department visits by 45% (HR 0.46, P = 0.01), and treatment discontinuations by 67% (HR 0.30, P = 0.02). These benefits likely reflect early detection of the unpredictable, delayed-onset toxicities characteristic of ICIs [9]. Despite high patient satisfaction (100% with ≥ 90% usability agreement), 30–40% of patients expressed concerns about inadequate clinician review of submitted reports [18], revealing a *critical implementation gap.* Therefore, we must ensure nurses read these reports and highlight important message to treating clinicians. It is notable that 7.3% of eligible patients were excluded due to digital literacy barriers [12], highlighting equity concerns in technology-dependent interventions.

Clinical implications

- Integrate multi-modal pain management: Combine educational, physical, and cognitive-behavioral approaches tailored to individual needs; no single intervention suffices in the long run [15,16].
- Implement routine sleep screening: Given 51.9% prevalence and survival implications, systematically assess sleep disturbances in all ICI-treated patients [19].
- Ensure responsive ePRO workflows: Establish clear protocols for timely clinician review and response to maximize safety benefits and patient trust [12,18].

- Address digital equity: Develop alternative monitoring strategies for patients with limited digital literacy or access [12].
- Design longitudinal interventions: Incorporate extended follow-up (minimum 6 months, ideally 12 + months) and maintenance strategies aligned with chronic immunotherapy duration rather than time-limited programs. Include booster sessions and ongoing support mechanisms to sustain intervention effects throughout the ICI treatment continuum [9,15].
- Target symptom clusters: Address pain, sleep, and fatigue as interconnected symptoms sharing inflammatory mechanisms [19].

Limitations of this report

Key limitations include heterogeneity of study designs, cancer types, and outcome measures precluding meta-analysis; geographic concentration (50% from China) limiting generalizability [11,12,16,17,19]; predominance of tertiary hospital settings with limited evidence for community care; lack of formal quality assessment; and English-language restriction potentially missing relevant studies. In addition, short follow-up durations (most ≤ 8 weeks, with only one study achieving 6 months) represent a critical limitation given that ICI therapy typically continues for months to years, with subsequent lines of treatment being common in melanoma and other malignancies. This temporal mismatch between intervention follow-up and treatment duration limits our ability to assess long-term sustainability and cumulative symptom burden management. The predominantly short follow-up periods may underestimate intervention attenuation over time and fail to capture late-onset sleep disturbances or chronic pain patterns characteristic of prolonged immunotherapy. Future studies should incorporate follow-up periods extending beyond 6 months to align with real-world ICI treatment durations and adequately evaluate intervention sustainability.

Conclusion

Considering the prevalent concurrent pain and sleep disturbances in cancer patients receiving ICIs, integrated management of pain-sleep clusters may be the best target for further nursing interventions. Identifying the differences in symptom burden of ICIs among patients across disease stages, improving coping skills for symptom-related distress, and evidence-based nursing assessment may be powerful measures to improve the management of pain-sleep symptom complexity. Future research must develop nurse-delivered integrated interventions addressing these interconnected symptoms while ensuring equitable access across diverse healthcare settings. Hopefully this updated review can serve as a useful reference at the point of care, not only for nurses, but social workers, pharmacists, and clinicians.

Declarations

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Author contributions

OA: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft, Project Administration. GS: Supervision, Writing – Review & Editing. AD, EY, PT, SA: Methodology, Writing – Review & Editing. All authors approved the final manuscript.

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Ethical approval and consent to participate

Ethical approval was not required for this scoping review, as it is based entirely on analysis of previously published literature. No human participants were directly involved; therefore, informed consent was not applicable.

Clinical trial number

not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Data availability

All data are derived from published studies and already summarized in the tables.

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Figures

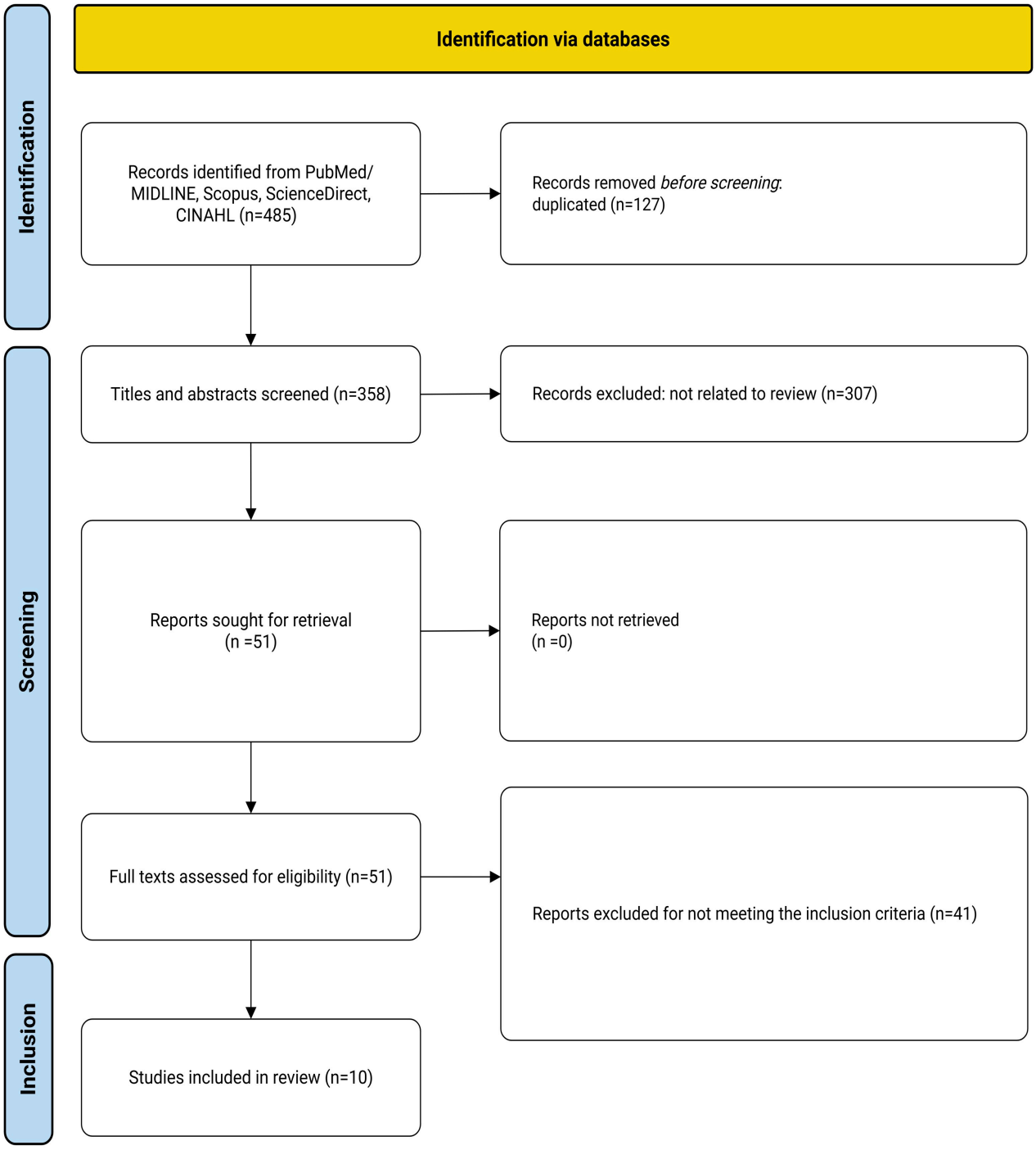


Figure 1

Flow diagram for Preferred reporting items for systematic review and meta-analysis-scoping review (PRISMA-ScR)