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Continuity of Care and Unmet Supportive Needs Among Women Living with Cancer: A Patient-Centered Perspective

[1] Riska Hediya Putri
[1] Yunina Elasari
[2] Tri Adi Nugroho
[3] Agus Byna

[1] Department of Nursing, Faculty of Health Sciences, Aisyah University of Pringsewu, Lampung, Indonesia
[2] Department of Medical Record and Health Information, Faculty of Health Sciences, Aisyah University of Pringsewu, Lampung, Indonesia
[3] Department of Information Systems, Faculty of Science and Technology, Sari Mulia University, Banjarmasin, Indonesia.

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Author for correspondence:
Riska Hediya Putri
Faculty of Health Sciences, Aisyah University of Pringsewu, Lampung, Indonesia
E-mail: riskahediya17@aisyahuniversity.ac.id

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Abstract

Introduction. Continuity of care is a critical element in enhancing the quality of cancer management, particularly for women who frequently encounter fragmented care and numerous unmet supportive care needs throughout their cancer trajectory. Understanding the extent of patients' supportive care requirements and their perceptions of continuity of care is essential for improving patient-centered oncology services.

Aim. This study aimed to explore women's perceptions of continuity of care and to identify their unmet supportive care requirements throughout various stages of the cancer care continuum.

Methods. A descriptive cross-sectional study was conducted among 134 women with cancer at Jendral Ahmad Yani Metro Hospital, Lampung, Indonesia, from 15 July to 9 August 2025, using the Supportive Care Needs Survey-SF34 and the Patient Continuity of Care Questionnaire-12 to assess supportive care needs and continuity of care. All procedures received ethical approval, and informed consent was obtained from participants.

Result. The highest unmet supportive care needs were observed in the Health System and Information domain, particularly regarding inadequate written information (71.6%) and information on cancer status, including whether the disease was under control or in remission (67.2%). The Physical and Daily Living domain had the second-highest level of unmet needs, particularly for pain (79.9%) and fatigue

(79.1%). Psychological concerns were also frequently reported, including fear of metastasis (63.4%) and anxiety about the future (59.7%). The Patient Care and Support domains as well as Sexuality domains demonstrated lower, but still notable, unmet needs (38–45%). The mean total PCCQ-12 score was 43.93 (SD = 6.04), indicating moderate to good continuity of care, with the highest mean observed in the Management Continuity domain (15.65; SD = 2.27) and lower scores in informational and relational continuity domains.

Conclusion. Women with cancer experience substantial unmet supportive care needs alongside moderate continuity of care. Strengthening communication, coordination, and emotional support is essential to enhance patient-centered oncology nursing practice and improve care continuity across transitions.

Introduction

Cancer stands as one of the foremost factors influencing health challenges and loss of life worldwide, with a significant impact on women. As reported by the Global Burden of Cancer (Globocan) 2020, female breast cancer was the most commonly diagnosed cancer worldwide, accounting for 11.7% of all new cases, and it also ranked among the leading causes of cancer-related mortality in women. It is followed by lung (11.4%), colorectal (10.0%), stomach (5.6%), and other site-specific cancers (1). The World Health Organization (WHO) documented a total of 396,914 cancer cases in Indonesia. Breast cancer was the predominant proportion, accounting for 42.1% of cases. Cervical cancer was the second most common malignancy, with 36,633 cases (9.2%), while ovarian cancer ranked third among women in Indonesia, with 14,896 cases (1,2). The Indonesian Cancer Foundation in Lampung stated that 5,672 of the 8,117,000 population were diagnosed with cancer, with the biggest proportions of cases being breast, cervical, and ovarian cancer (3).

The effects of cancer and its treatments are deeply felt by individuals, highlighting the need for a holistic approach to care that goes beyond just medical treatment (4). This comprehensive viewpoint is essential for women diagnosed with different cancers, due to their unique physiological and psychosocial challenges (5). Despite increasing acknowledgment of the significance of supportive care, a considerable burden of unmet needs continues to exist across multiple supportive care areas for numerous cancer patients throughout all stages of their illness (6). This unmet need frequently arises from inadequate care coordination and insufficient recognition of individual patient requirements within intricate healthcare systems (7). Therefore, understanding these unmet requirements from a patient-centered perspective is essential for developing tailored interventions and enhancing overall well-being (8).

Women with cancer experience a noticeable emotional and physical burden; nonetheless, information concerning their specific supportive care requirements and access to pertinent treatments is still restricted (9). Existing literature indicates that many women with cancer often report non-physical needs, such as anxiety about relapse or metastasis, more frequently than physical symptoms (10). Furthermore, this holistic assessment should also consider the profound impact of cancer on psychological well-being, including fears of recurrence, concerns for loved ones, and uncertainty about the future, which are frequently reported as high-priority unmet needs among cancer survivors (11). This highlights the importance of healthcare professionals evaluating these complex needs thoroughly, extending beyond the treatment of physical conditions (12).

Effective coordination of care and comprehensive survivorship services are essential for addressing the diverse needs of cancer survivors, especially women who may face specific challenges associated with their cancer type and treatment (13,14). A key element of comprehensive care is continuous follow-up support to manage late and long-term side effects, monitor for relapse, and address new or pre-existing comorbidities (15). Continuous Nursing Care is a comprehensive approach in which patients are actively involved in decision-making and in creating personalized nursing care plans that cater to their unique needs, from admission to discharge. The objective of ongoing nursing care is to enhance patients' quality of life, promote physical rehabilitation, and support them in optimizing their health status in accordance with their individual needs (16,17).

Continuous nursing care from hospitalization to post-discharge follow-up is beneficial for patients.

In Indonesia, only a limited number of hospitals have implemented follow-up procedures to assess patients' conditions after discharge. Evidence from other countries, including the United Kingdom, indicates that nurses who provide follow-up services after hospital discharge can enhance patients' quality of life and effectively manage their ongoing care needs at home (18,19). Malignancies significantly impact women, with over one million survivors in the United States. This number is projected to increase by 33% over the next decade, underscoring the need for coordinated, ongoing supportive care to address persistent symptoms and potential long-term complications (20). This continuity is crucial for optimizing patient satisfaction and health outcomes, particularly given the complex and often fragmented nature of post-treatment surveillance and long-term care. Without robust continuity, patients face increased risks of unmet needs, compromised care quality, and poorer psychosocial adjustment during a vulnerable period (12,14).

Aim

This study investigates patients' perceptions of continuity of care and identifies the types and extent of their supportive care needs, aiming to provide evidence to enhance patient-centered cancer care services.

Methods

Study design and participants

This research employed a descriptive cross-sectional design to examine patients' perceptions of continuity of care and to identify the types and extent of their supportive care needs. The study was conducted using a convenience sampling approach at Jendral Ahmad Yani Metro Hospital in Lampung, Indonesia, over a four-week period from 15 July to 9 August 2025. Participants were eligible if they were women diagnosed with cancer, aged 18 years or older, currently receiving or having previously received cancer-related treatment at the hospital, able to communicate effectively, and willing to provide informed consent. Patients were excluded if they had severe cognitive impairment, were in critical clinical condition at the time of data collection, or submitted incomplete questionnaire responses.

The sample size was determined through an a priori power analysis using G*Power software (version 3.1.9.4). Assuming a medium effect size (r = 0.30), a two-tailed significance level of 0.05, and a statistical power of 0.95, the minimum required sample size was calculated to be 134 participants. Accordingly, 134 eligible individuals were recruited and included in the final analysis. The questionnaires were distributed by trained research assistants directly to the participants in their hospital rooms. Participants completed the questionnaires independently and returned them by placing the completed questionnaires into a closed collection box located at the nurse station. This procedure ensured the anonymity and confidentiality of responses, adhered to ethical standards, and complied with voluntary participation requirements.

Ethics

Participants engaged in a survey that ensured their anonymity. Before completing the survey, participants were informed about the research's purpose, and their involvement was entirely voluntary. The research protocol was reviewed and approved by the Ethics Committee of Jendral Ahmad Yani Hospital, Lampung, Indonesia, with approval number 370/634/KEPK-LE/LL-02/2025. All participants received comprehensive information about the study's objectives, methodologies, potential risks, and benefits. All participants provided written informed consent before data collection. Participation was completely voluntary, and respondents were assured they could withdraw at any time without repercussions regarding their medical treatment or nursing care.

Instruments

Supportive care needs were assessed using the Supportive Care Needs Survey Short Form (SCNS-SF34). The SCNS-SF34 is a validated 34-item question-

naire comprising five domains: physical and daily living, psychological, patient care and support, health system and information, and sexuality. Each item is rated on a five-point Likert scale ranging from 1 (not applicable) to 5 (high need). In this study, responses scored as 1 (not applicable) or 2 (satisfied) were categorized as indicating no unmet supportive care need. In contrast, responses scored 3 (low need), 4 (moderate need), or 5 (high need) were classified as indicating unmet supportive care needs, reflecting additional support that was not adequately addressed.

The SCNS-SF34 consists of 34 items divided into five domains: Psychological Needs (10 items), Health System and Information Needs (11 items), Patient Care and Support Needs (5 items), Physical and Daily Living Needs (5 items), and Sexuality Needs (3 items). Scores were calculated using a Likert summated scale by summing individual item scores within each domain, in accordance with the SCNS scoring guidelines. The resulting scores were analyzed either as crude totals or converted into standardized scores to enable comparison across scales with different numbers of items. Standardized scores were calculated using the formula:

$$(\sum item\ scores - m)\ x\ 100/[m\ x\ (k-1)]$$

where *m* represents the number of items in the domain and represents the maximum response value for each item. This scoring approach follows the recommendations outlined in the Supportive Care Needs Survey: A Guide to Administration, Scoring and Analysis (21). The SCNS-SF34 had a validity score of 0.302-0.792 and the reliability 0.933 (9).

The Patient Continuity of Care Questionnaire short version (PCCQ-12) was utilized to assess patients' perceptions of continuity of care. The PCCQ-12 consists of three domains: informational continuity (4 items), management continuity (4 items), and relational continuity (4 items). Each item has five response options ranging from strongly disagree to strongly agree, scored from 1 to 5, with higher scores indicating better continuity of care. All items also include a "not applicable" option, which is treated as a missing response and excluded from scoring. For each domain, the domain score is calculated by summing the scores of its constituent items, using only responses scored 1–5. The domain score therefore ranges from 4 to 20 for each domain. The total PCCQ-12 score is the sum of all 12 items, with a potential range from 12 to 60, where higher scores reflect better overall continuity of care (22). The PCCQ-12 were translated from English to Bahasa Indonesia by an academic language center, followed by a review conducted by an expert panel. The PCCQ-12 underwent piloting for validity and reliability testing, yielding validity scores ranging from 0.512 to 0.828 and a reliability score of 0.887.

Statistics

Descriptive statistics were used to summarize patients' demographic characteristics, perceptions of continuity of care, and supportive care needs. The normality of continuous variables was assessed using the Kolmogorov-Smirnov test, which indicated that both perceptions of continuity of care and supportive care needs were normally distributed, justifying the use of parametric statistical analyses. All statistical analyses were performed using Statistical Package for Social Sciences (SPSS version 26.0, IBM Corp.).

Results

The sociodemographic characteristics of women with cancer included in the study are presented in Table 1.

Table 1 findings indicated that the majority of respondents belonged to the middle adulthood group (43.3%), with educational backgrounds primarily at the lower and upper secondary education levels. A significant proportion of respondents were unemployed (65.7%) and had incomes below the minimum wage (76.9%), reflecting constrained socioeconomic conditions. Breast cancer was the most prevalent type reported, accounting for 79.9%, whereas other cancers, including colon cancer, rectal cancer, and multiple myeloma, were identified in a minor percentage of respondents. A significant majority of patients (48.5%) were diagnosed at advanced stage (III), indicating a low rate of early detection. The predominant ethnicity among respondents was Javanese, comprising 79.1% of the sample. The predominant treatment duration ranged from 1 to 6 months, accounting for

Table 1. **The sociodemographic characteristics of women with cancer**

Characteristics		Frequency	%
Age	Young adulthood (25 – 44 years)	51	38.1
	Middle adulthood (45 – 59 years)	58	43.3
	Elderly (60 – 75 years)	25	18.7
Educational qualifications	Primary education	31	23.1
	Lower secondary education	44	32.8
	Upper secondary education	43	32.1
	Higher education (Diploma/Bachelor's degree)	13	9.7
Occupation	Unemployed	88	65.7
	Employed	46	34.3
Income	Below the minimum wage	103	76.9
	At or above the minimum wage	31	23.1
Type of Cancer	Breast cancer	107	79.9
	Multiple myeloma	6	4.5
	Ovarian cancer	1	0.7
	Rectal cancer	6	4.5
	Hodgkin's lymphoma	2	1.5
	Lung cancer	1	0.7
	Colon cancer	9	6.7
	Adenocarcinoma	1	0.7
	Non-Hodgkin's lymphoma	1	0.7
Stage	Stage I	7	5.2
	Stage II	54	40.3
	Stage III	65	48.5
	Stage IV	8	6.0
Duration of Treatment	1 – 6 months	82	61.2
	>6 months – 1 year	50	37.3
	>1 year	2	1.5
Treatment	Chemotherapy	20	14.9
	Surgery and Chemotherapy	114	85.1
Ethnicity	Balinese	5	3.7
	Batak	1	0.8
	Javanese	106	79.1
	Lampungese	6	4.5
	Minangkabau	5	3.7
	Palembangese	2	1.5
	Sundanese	1	0.7
	Other/Not Reported	8	6.0

61.2% of cases, while the combination of surgery and chemotherapy was the most commonly utilized therapy, representing 85.1% of instances.

Tables 2 and 3 present the supportive care needs among women with cancer, with Table 2 showing the distribution of needs across domains and Table 3 highlighting the prevalence of moderate-to-high unmet needs in each domain.

Table 2. **Supportive Care Needs variables among women with cancer**

Variables	Frequency	%
Supportive Care Needs		
No Need	16	11.9
Unmet Need	118	88.1
Physical and Daily Living Domain		
No Need	25	18.7
Unmet Need	109	81.3
Psychological Domain		
No Need	42	31.3
Unmet Need	92	68.7
Patient Care and Support Domain		
No Need	57	42.5
Unmet Need	77	57.5
Health System and Information Domain		
No Need	24	17.9
Unmet Need	110	82.1
Sexuality Domain		
No Need	80	59.7
Unmet Need	54	40.3

Table 2 and Table 3 present the distribution of unmet supportive care needs among cancer patients across five primary domains. Unmet supportive care needs were defined as item responses scored 3 (low need), 4 (moderate need), or 5 (high need) on the Supportive Care Needs Survey (SCNS). Scores of 1 (not applicable) and 2 (satisfied) indicate no unmet need. Domain-level unmet needs represent summary categories derived from item-level responses within each SCNS domain.

The findings indicate that the Health System and Information domain exhibited the highest proportion of unmet needs. Patients most frequently reported requiring adequate written information regarding illness management and treatment outcomes (71.6%), as well as information on cancer status, including whether the disease was under control or in remission (67.2%).

The Physical and Daily Living domain had the second-highest level of unmet needs. Pain (79.9%) and fatigue/lack of energy (79.1%) were the predominant issues, suggesting that physical symptoms remain the most significant challenges in patients' daily lives. Psychological needs were also frequently reported, including feelings of sadness (61.2%), anxiety and concern about the future (59.7%), and fears of cancer spreading (63.4%), indicating that emotional distress among patients is substantial and often insufficiently addressed. The Patient Care and Support domain and Sexuality domain showed lower, yet meaningful levels of unmet needs, with approximately 38–45% of patients reporting challenges related to changes in sexual feelings, interpersonal relationships, and insufficient information regarding sexuality.

Table 4 presents the results of the Patient Continuity of Care Questionnaire short version (PCCQ-12), including mean scores for each domain and the overall total score.

The mean scores for the Patient Continuity of Care Questionnaire short version (PCCQ-12) are displayed in Table 4, including three domains and the overall patient perception score. The results suggest that patients experienced moderate to good continuity of care. The Informational Continuity domain recorded a mean score of 14.15 (SD = 2.623), where the item with the highest score pertained to comprehensive information on medications, while the item with the lowest score was associated with clarity of prognosis. The Management Continuity domain exhibited the highest overall mean (15.65; SD = 2.265), indicating effective coordination and follow-up arrangements post-discharge, although the consistency of information among providers was relatively lower. The Relational Continuity domain yielded a mean score of 14.12 (SD = 2.271), suggesting that patients perceived themselves as sufficiently prepared for discharge, yet reported a lack of familiarity with providers post-discharge. The total score reflecting patients' perceptions of continuity of care was 43.93 (SD = 6.038), with a range of 31–60. Higher scores indicate better perceived continuity of care. Clinically, this suggests that the participants experienced moderate to good continuity of care.

Table 3. **Prevalence of unmet supportive care needs among women with cancer**

Unmet Supportive Care Needs	Frequency	%
Physical and Daily Living Domain		
Pain	107	79.9
Lack of energy/tiredness	106	79.1
Feeling unwell a lot of the time	80	59.7
Work around the home	91	67.9
Not being able to do the things you used to do	94	70.1
Psychological Domain		
Anxiety	80	59.7
Feeling down or depressed	73	54.5
Feelings of sadness	82	61.2
Fears about the cancer spreading	85	63.4
Worry that the results of treatment are beyond your control	79	59.0
Uncertainty about the future	80	59.7
Learning to feel in control of your situation	74	55.2
Keeping a positive outlook	50	37.3
Feelings about death and dying	56	41.8
Concerns about the worries of those close to you	52	38.8
Patient Care and Support Domain		
More choice about which cancer specialists you see	37	27.6
More choice about which hospital you attend	21	15.7
Reassurance by medical staff that the way you feel is normal	61	45.5
Hospital staff attending promptly to your physical needs	42	31.3
Hospital staff acknowledging, and showing sensitivity to your feelings and emotional needs	61	45.5
Health System and Information Domain		
Being given written information about the important aspects of your care	46	34.3
Being given information (written, diagrams, drawings) about aspects of managing your illness and side-effects at home	96	71.6
Being given explanations of those tests for which you would like explanations	52	38.8
Being adequately informed about the benefits and side-effects of treatments before you choose to have them	39	29.1
Being informed about your test results as soon as feasible	72	53.7
Being informed about cancer which is under control or diminishing in remission)	90	67.2
Being informed about things you can do to help yourself get well	61	45.5
Having access to professional counselling (e.g., psychologist, social worker, counsellor, nurse specialist) if you, your family or friends need it	42	31.3
Being treated like a person not just another case	18	13.4
Being treated in a hospital or clinic that is as physically pleasant as possible	30	22.4
Having one member of hospital staff with whom you can talk to about all aspects of your condition, treatment and follow-up	59	44.0
Sexuality Domain		
Changes in sexual feelings	52	38.8
Changes in your sexual relationships	51	38.1
To be given information about sexual relationships	53	39.6

Table 4. **The Patient Continuity of Care Questionnaire short version (PCCQ-12)**

Variables	Mean (SD)	Median	Mode	Min-Max
Patients' perceptions of continuity of care	43.93 (6.038)	44.00	48	31-60
Informational	14.15 (2.623)	14.00	16	8-20
I was provided with clear information on my diagnosis.	4.00 (0.704)	4.00	4	1-5
I was provided with clear information on my prognosis.	2.94 (1.249)	3.00	4	1-5
I was given information on symptoms that may signal a need to seek urgent medical attention and whom to contact for these symptoms (e.g., specialist, family physician, homecare).	2.96 (1.204)	3.00	4	1-5
I was given complete information on my medications (e.g., type, purpose, method of administration, timing, duration, dosage, side effects, drug interactions, and required blood work).	4.25 (0.677)	4.00	4	2-5
Management	15.65 (2.265)	16.00	16	9-20
I was given information on follow-up appointments that have been made for me and appointments I have to schedule for myself.	4.43 (0.606)	4.00	5	2-5
I was informed of ongoing treatment that may be required after discharge (e.g., purpose, how, when) and whether I will have ongoing contact with providers of my care (e.g., physician, etc.).	3.84 (0.900)	4.00	4	1-5
A well- developed and realistic follow-up plan was prepared and explained to me.	3.84 (0.777)	4.00	4	1-5
I was given consistent information by all providers about my care.	3.54 (0.690)	3.50	3	2-5
Relational	14.12 (2.271)	14.00	16	10-20
I felt "known" by the providers involved in my care (e.g., they were aware of my current clinical condition and recent events).	3.69 (0.750)	4.00	4	2-5
I felt adequately prepared for discharge.	3.72 (0.633)	4.00	4	2-5
I feel "known" (e.g., current health condition) by my present providers who have taken over my care since discharge.	3.34 (0.796)	3.00	4	1-5
I have confidence in my providers who have taken over my care since discharge.	3.37 (0.712)	3.00	3	2-5

Discussion

Supportive care needs encompass the requirements for managing symptoms and treatment-related side effects, enhancing adaptive and coping abilities, optimising understanding and access to information for informed decision-making, and minimising impairments in physical functioning (23). Consistent with this framework, the findings of the present study demonstrate that women with cancer reported the highest unmet supportive care needs in the Health System and Information domain, followed by the Physical and Daily Living domain, with considerable unmet needs also evident in the Psychological domain. This distribution indicates that gaps in information provision and communication within the healthcare system may undermine patients' capacity to manage physical symptoms, adapt psychologically, and maintain daily functioning. Adequate, timely, and comprehensible information is therefore fundamental to strengthening patients' self-efficacy, supporting effective coping strategies, and promoting active engagement in self-care. In this context, nurses play a central role in identifying unmet supportive care needs and delivering person-centred education and support tailored to patients' informational, physical, and psychological concerns.

Supportive care requirements are categorised into five domains: physical, psychological, patient care and support, health system and information, and sexuality. This study found that 88.1% of cancer patients

required supportive care. In the physical domain, 81.3% of cancer patients indicated a requirement for supportive care, whereas in the health system and information domain, 82.1% reported comparable needs. These results highlight that, although cancer care often emphasizes physical treatment, patients continue to experience significant unmet supportive care needs, particularly in the physical, emotional, and informational domains. Overall, the findings emphasize the necessity of a comprehensive, patient-centered approach to oncology nursing that addresses not only physical treatment but also emotional, informational, and psychosocial aspects of care to meet patients' supportive care needs adequately.

This finding is consistent with the study by Effendy et al., which reported a wide range of unmet physical symptom needs among patients with advanced cancer. Specifically, unmet needs were reported for pain (66.4%), fatigue (60.0%), sleeping problems (65.6%), shortness of breath (67.3%), cough (63.2%), itch (61.7%), numbness (54.1%), and night sweats (76.2%). The higher proportions observed in the present study, particularly for pain and lack of energy, may be partly explained by differences in study populations. Effendy et al. included only patients with advanced-stage cancer, who often experience more complex and fluctuating symptom patterns and may receive more intensive palliative-oriented care. In contrast, variations in disease stage and treatment trajectories in the present study may have contributed to differences in symptom burden and access to supportive care services. Price et al. conducted an investigation into physical symptoms in patients with ovarian cancer, identifying lack of energy, abdominal bloating, pain, and nausea as the most commonly reported symptoms. Key issues associated with cancer and its treatment include disruptions in physical condition, social functioning, and body image. Patients frequently encounter uncertainty about the significance of unexplained physical symptoms and the management of ongoing treatment effects during their care (24,25).

These findings highlight two interrelated challenges in cancer care: the burden of treatment-related physical symptoms and the persistent gap in patients' access to clear and reliable health information. Physical challenges such as fatigue and pain remain among the most prevalent adverse effects of cancer treatment, underscoring the need for effective symptom management strategies. Evidence suggests that improved symptom control can substantially enhance patients' quality of life, as demonstrated by Li et al. (26). In parallel, unmet informational needs reflect an emerging "infodemic" in healthcare, in which patients may experience confusion or anxiety due to fragmented or inconsistent information. Holden et al. (2021) emphasised the critical role of health literacy and the responsibility of healthcare professionals to provide accurate and comprehensible information to mitigate patient distress (27). Collectively, these observations are consistent with previous studies highlighting that integrated attention to both physical and informational needs is essential for improving overall patient well-being.

Unmet psychological needs were reported by 68.7% of respondents. The diagnosis and treatment of cancer frequently induce anxiety, depression, and concerns regarding relapse. Cancer patients undergoing therapy encounter not only physical symptoms but also emotional alterations, including anxiety and depression, alongside concerns regarding a potential decline in their quality of life due to uncertainty about their prognosis. Cancer patients frequently present with multiple interrelated symptoms; for example, depression may correlate with fatigue. The interaction of concurrent symptoms may intensify existing symptoms or contribute to the emergence of new symptoms (28). Emotional well-being is the dimension most adversely impacted during chemotherapy. Cancer patients receiving treatment necessitate emotional support to manage anxiety, sadness, and fear during the diagnosis and treatment phases (29).

One of the most alarming discoveries in this study is that nearly 89% of respondents were diagnosed with breast cancer at advanced stages (II and III). This highlights a major challenge in the early detection process. According to Siegel et al. (2022), early detection remains the key to improving survival rates, even with advances in treatment options. Insufficiently organized and cost-effective screening initiatives, coupled with a general unawareness of the initial signs of cancer, are often associated with delayed diagnoses (30). Following established global clinical guidelines, the typical treatment strategy for stage II and III breast cancer involves a combination of chemotherapy and surgery, a choice favored by most patients.

The treatment typically lasts from one to six months, though this timeframe can vary. Papalexis et al. conducted a systematic review highlighting the impor-

tance of tailored therapy and the thorough management of side effects, especially for patients receiving long-term chemotherapy (31). The significant presence of respondents from the Javanese ethnic group likely reflects the study's geographical context; however, it is crucial to consider the influence of ethnicity and culture. Özdemir et al. (2017) illustrated that ethnic background and genetic lineage can influence particular cancer types and treatment responses. Cultural influences, such as the stigma associated with illness and reliance on traditional medicine, may prevent patients from seeking professional medical attention, resulting in diagnoses occurring at more advanced stages (32). Consequently, it is imperative for nurses to actively provide supportive care by facilitating effective communication with patients and disseminating vital care-related information to enhance the quality of life for cancer patients. Continuous Nursing Care is an extensive nursing care approach that engages patients in decision-making and the formulation of personalised care plans, extending from hospital admission to discharge and customised to each patient's distinct needs.

Continuity of care, which encompasses seamless coordination and effective transitions across healthcare services, is widely recognised as a key indicator of healthcare quality. In the context of cancer care, where management extends beyond curative treatment to include supportive, rehabilitative, and palliative services delivered by multidisciplinary teams, patients' favourable perceptions of continuity of care are associated with better perceived health status and overall well-being (16,17). The findings of the present study suggest that coordination and communication among healthcare providers were generally perceived as adequate; however, opportunities for improvement remain, particularly in informational and relational continuity. When patients perceive that their supportive care needs are adequately met, they are more likely to report a positive perception of continuity of care, highlighting the importance of integrated, patient-centred approaches to cancer care.

Cancer patients' needs encompass not only medical interventions like chemotherapy, surgery, or radiotherapy but also emotional, spiritual, and financial support. A favourable perception of care continuity enables patients to regard the treatment process as organised, consistent, and conducive to their overall well-being. Chen et al. (2019) conducted a study indicating that breast cancer survivors exhibiting a high Continuity of Care Index (COCI), regardless of whether oncologists or primary care providers managed their care, were more inclined to participate in routine screenings (e.g., mammography/ultrasound), experienced reduced hospitalisation rates, and had fewer emergency department visits in comparison to those with low continuity of care (33).

This study highlights the critical role of uninterrupted continuity of care and the systematic identification of unmet supportive care needs as essential components of patient-centered cancer care. The findings emphasize the importance of strengthening interprofessional communication, improving the clarity and consistency of information provided to patients, and enhancing care coordination, particularly during transitions from hospital to home. Clinically, these results support the implementation of structured patient education programs, routine monitoring of supportive care needs, and targeted nursing interventions focused on informational and emotional support. Future research should employ longitudinal and interventional designs to further evaluate the effectiveness of continuity of care models and supportive care interventions across different stages of the cancer trajectory and healthcare settings.

Several limitations should be considered when interpreting these findings. The cross-sectional design does not allow causal inferences, and the use of convenience sampling within a single hospital setting may limit transferability to other contexts. In addition, reliance on self-reported data may introduce response bias. Furthermore, the Patient Continuity of Care Questionnaire (PCCQ-12) includes only positively phrased statements, which may have led to more favorable responses than participants actually experienced.

Conclusion

This study indicates that women living with cancer reported varying levels of continuity of care across informational, management, and relational domains. Management continuity showed higher scores than informational and relational continuity, while gaps were identified in the clarity of prognostic information and in patients' familiarity with healthcare providers after hospital discharge. In addition, substan-

tial unmet supportive care needs were identified, particularly in the physical and daily living domain, including pain and fatigue, as well as in the psychological domain, such as emotional distress, anxiety, and fear of disease progression. Moderate unmet needs were also reported in the areas of patient care, support, and health system information. Overall, these findings reflect key challenges in delivering patient-centered cancer care that adequately addresses both continuity of care and patients' multidimensional supportive care needs.

Declaration of Generative AI in Writing

During preparation, the author(s) used ChatGPT from OpenAI for language enhancement.

Author Contributions

Conceptualization (RHP, YE); Data Curation (RHP, YE); Methodology (RHP, AG); Data Analysis (RHP, AG); Writing – Original Draft (RHP, YE); Writing—review and editing (RHP, TAN). All authors have approved the final manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Review

Efficacy of High-Flow Nasal Cannula in Preventing Hypoxemia During Sedated Endoscopic Procedures: A Literature Review

[1,2]Valentina Ješić
[3] Jadranka Pavić
[1] Marinko Vučić
[1] Tihana Magdić Turković
[3] Martina Smrekar

[1] Sestre milosrdnice University Hospital Center, Zagreb, Croatia, Department of Anesthesiology, Intensive Care Medicine and Pain Therapy, Zagreb, Croatia
[2] Faculty of Health Sciences, University of Novo Mesto, Novo Mesto, Slovenia
[3] University of Applied Health Sciences, Zagreb, Croatia

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Author for correspondence:
Valentina Ješić
Sestre milosrdnice University Hospital Center, Zagreb, Croatia
E-mail: valentina.matic@yahoo.com

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Abstract

Introduction. Hypoxemia is a common and potentially serious complication during endoscopic procedures performed under sedation, particularly in patients with obesity, chronic respiratory disease, or reduced pulmonary reserve. The high flow nasal cannula (HFNC) delivers heated and humidified oxygen at high flow rates with a stable fraction of inspired oxygen (FiO_2), thereby reducing desaturation and improving oxygenation compared with conventional oxygen delivery methods.

Aim. This review evaluated the efficacy of HFNC in preventing hypoxemia during gastrointestinal endoscopy, bronchoscopy, and endoscopic retrograde cholangiopancreatography (ERCP) under sedation, focusing on clinical applicability and patient safety.

Methods. A systematic search of PubMed, Web of Science, and Scopus (2015-2025) identified English language studies, including randomized trials, comparative and observational studies, and reviews. Predefined inclusion criteria were applied, and outcomes included the incidence of hypoxemia, minimum SpO_2, and the need for airway interventions.

Results. Of 628 records screened, 30 studies met the inclusion criteria (13 randomized trials, 3 prospective comparative, 1 observational, 3 retrospective, and 10 systematic reviews or meta-analyses). Most confirmed that HFNC reduces hypoxemia, increases minimum SpO_2, and improves ventilation stability compared with conventional oxygen therapy. The greatest benefits were observed among high-risk patients such as elderly, obese, and those with respiratory disease. Optimal flow rates ranged from 50 to 60 L/min, ensuring efficacy, comfort, and safety.

Conclusion. HFNC provides effective oxygenation support during sedated endoscopic procedures, reducing desaturation and the need for airway interventions. Standardized protocols and further research on long term outcomes are recommended.

Introduction

Hypoxemia is one of the most common and serious complications during sedated endoscopic procedures, particularly in patients at increased risk due to respiratory diseases, obesity, or other factors that reduce pulmonary reserve (1). Conventional methods of oxygenation support, such as conventional oxygen therapy (COT) delivered via nasal cannula or face mask, are often insufficient to maintain adequate oxygenation in conditions of increased oxygen demand and reduced respiratory volume caused by sedation (2). Therefore, advanced non-invasive oxygenation methods are increasingly being applied in clinical practice, among which the high-flow nasal cannula (HFNC) is gaining an increasingly important role.

HFNC delivers heated and humidified oxygen at high flow rates (typically 30–60 L/min) with precise control of the fraction of inspired oxygen (FiO_2) (3). This technology provides partial positive pressure support (PEEP effect), reduces dead space in the upper airways, improves alveolar ventilation, and enhances overall gas exchange (4). HFNC increases the partial pressure of arterial oxygen (PaO_2), reduces respiratory effort, and improves patient comfort compared with traditional methods (5). In addition, continuous airflow through the upper airways prevents rebreathing of carbon dioxide (CO_2), thereby reducing the risk of hypercapnia, which is a common problem in sedated patients during procedures such as bronchoscopy, gastroscopy, or endoscopic retrograde cholangiopancreatography (ERCP).

The significance of HFNC is particularly evident in patients at high risk of developing hypoxemia, including elderly individuals, patients with elevated BMI, those with chronic lung diseases (e.g., COPD, interstitial lung disease), and patients undergoing prolonged or invasive endoscopic procedures (6,7). Numerous studies and meta-analyses report that HFNC reduces the incidence of hypoxemic episodes, the need for procedural interruptions, and additional airway interventions (e.g., mask ventilation, intubation), while simultaneously increasing minimum oxygen saturation (SpO_2). Compared with COT or low-flow oxygen therapy, HFNC provides more stable oxygenation and better control of ventilation parameters, thereby contributing to the safer performance of procedures (8).

Despite the increasing use of HFNC, its application in procedural sedation and endoscopy has not yet been standardized, and the determination of optimal flow rates and indications varies across clinical centers in different countries. In addition, considerable heterogeneity exists regarding study design, sedation protocols, and definitions of hypoxemia, which complicates the development of unified guidelines. Given the growing number of endoscopic procedures performed under sedation and the increasingly complex patient population, there is a need for a detailed analysis of the effectiveness of HFNC in this context. Numerous studies have shown that the incidence of hypoxemia during gastrointestinal endoscopy under sedation may range from as low as 1.8% to as high as 69% (9–12).

Aim

The purpose of this paper is to systematically analyze the existing scientific literature on the effectiveness of high-flow nasal cannula (HFNC) in managing hypoxemia during endoscopic procedures. The study aims to identify the advantages of HFNC in comparison with conventional methods of oxygenation support. A particular emphasis was placed on outcomes such as improved oxygenation, reduced need for invasive ventilation, and patient safety.

Methods

A systematic literature search was conducted in July 2025 using the PubMed, Web of Science, and Scopus databases. Scientific articles published between 2015 and 2025 were reviewed. In accordance with PRISMA guidelines for systematic reviews, only articles classified as Clinical Trial, Controlled Clinical Trial, Multicenter Study, Observational Study, Randomized Controlled Trial, Review, and Systematic Review were included.

Inclusion criteria comprised studies focusing on the use of high-flow nasal cannula (HFNC) in adult patients with hypoxemia, including gastrointestinal endoscopy (gastroscopy, colonoscopy, EGD), bronchoscopy, and endoscopic retrograde cholangiopancreatography (ERCP) performed under sedation. Predefined search keywords were used: "high flow nasal cannula," HFNC, and hypoxemia. These terms were required to appear in the title, abstract, or keywords of the included articles to ensure their relevance.

Only studies published between 2015 and 2025 were included. This period was selected to capture the most recent decade of scientific evidence, reflecting advances in high-flow nasal cannula technology, evolving procedural sedation protocols, and the growing number of clinical trials in this field. Studies published before 2015 were excluded to avoid outdated technologies and practices that no longer represent current standards.

The authors predefined the search objectives, established inclusion and exclusion criteria (see Table 1), and focused the analysis on studies investigating the use of HFNC compared with COT in adult patients. The search was further limited to articles available in English and required to contain either an abstract or full text. After duplicate removal using the Zotero application, a total of 628 records were identified for review (Figure 1). Two independent authors screened the titles and abstracts (n = 628), excluding 384 studies that did not meet the basic inclusion criteria or were deemed irrelevant. Full-text articles were retrieved for 244 studies and assessed for eligibility. In the final selection round, 214 articles were excluded because they were not related to endoscopic procedures, resulting in 30 studies being included in the analysis, all directly addressing HFNC use in relation to endoscopic procedures.

Data extraction was conducted independently by two authors (VJ and JP), with accuracy verified through mutual comparison and consensus among all authors. The quality of the included studies was evaluated according to predefined criteria encompassing study design, sample size, outcome reporting, and overall methodological rigor.

Table 1. **Inclusion and exclusion criteria**

Inclusion criteria	Exclusion criteria
Studies published between January 2015 and June 2025	Studies published before 2015
Original research articles available in English with accessible abstract or full text	Articles in languages other than English; editorials, letters, commentaries, books, or conference abstracts
Clinical and review studies: randomized controlled trials (RCTs), controlled clinical trials, multicenter studies, observational (prospective and retrospective), systematic and narrative reviews	Case reports, study protocols, low-quality meta-analyses, animal experiments, or studies lacking accessible abstract/full text
Studies investigating the use of HFNC in adults with acute respiratory failure or hypoxemia during endoscopic procedures under sedation, including gastrointestinal endoscopies (gastroscopy, colonoscopy, EGD), bronchoscopy, and ERCP under sedation	Studies involving pediatric or neonatal patients; studies in non-acute or chronic settings (e.g., COPD); studies not related to endoscopic procedures (e.g., ARDS studies or ICU weaning protocols)
Studies reporting outcomes such as hypoxemia incidence, oxygenation parameters, airway interventions, or procedure interruptions	Studies without clinically relevant outcomes.

Results

This systematic review includes 30 studies published between 2015 and 2025. The included studies evaluated the effectiveness of high-flow nasal cannula (HFNC) in preventing hypoxemia during sedated endoscopic procedures, including gastrointestinal endoscopy, bronchoscopy, and endoscopic retrograde cholangiopancreatography (ERCP). The PRISMA diagram (Figure 1) illustrates the selection

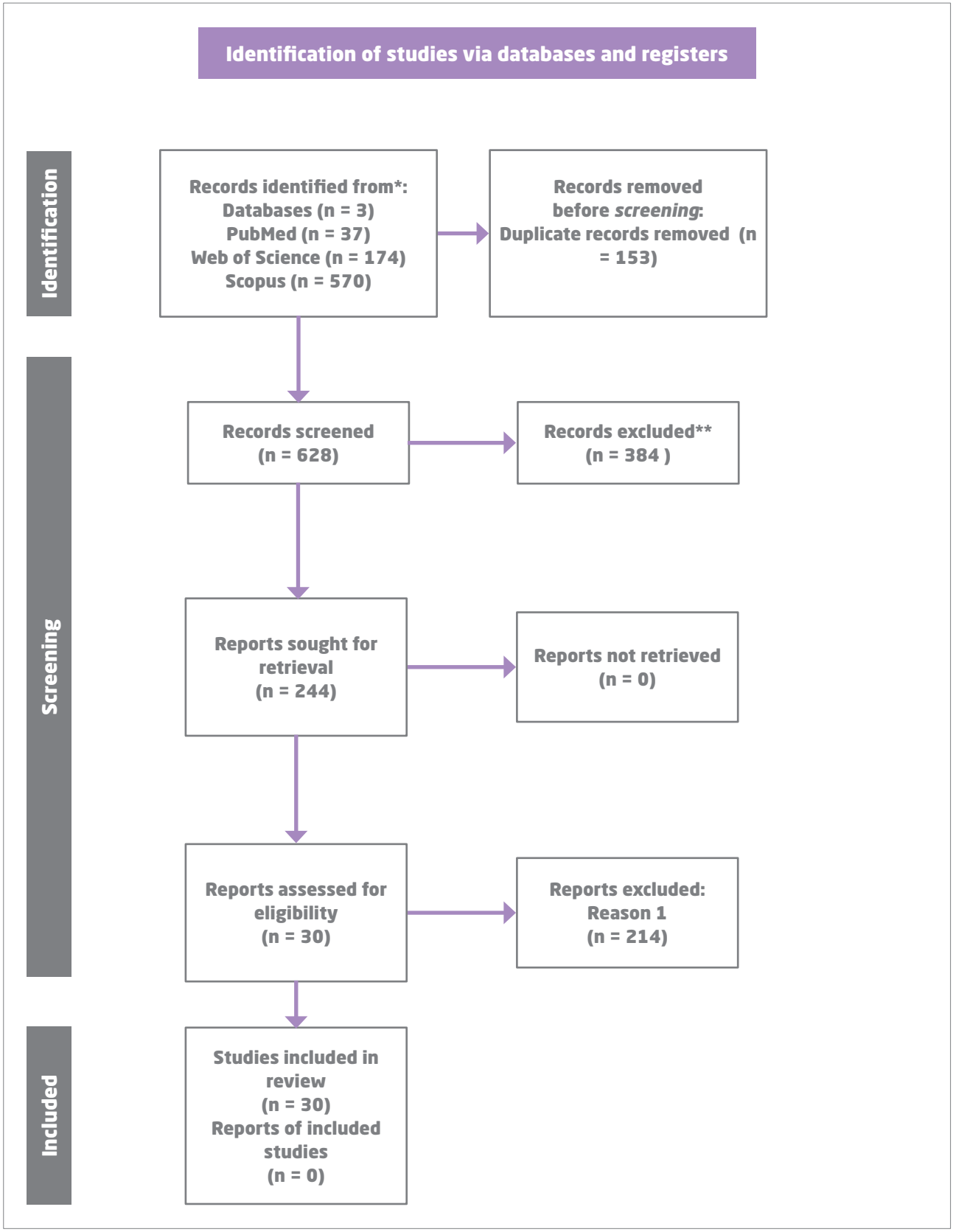

Figure 1. **PRISMA flow chart**

process, and Table 2 provides a detailed overview of the included studies, including authors, study design, population characteristics, and key findings. To avoid redundancy, detailed numerical results are summarized in Table 2.

Most of the studies were conducted in China (n = 13), with additional studies originating from Japan (n = 2), South Korea (n = 2), Australia (n = 2), Taiwan (n = 2), and Greece (n = 2), as well as single studies from Thailand, Egypt, Ecuador, France, India, and the United States. By study type, the included papers comprised 13 randomized controlled trials (RCTs), 3 prospective randomized comparative studies, 1 prospective observational study, 3 retrospective studies, and 10 systematic reviews and meta-analyses.

As shown in Table 2, most studies confirmed that HFNC significantly reduces the incidence of hypoxemia compared with COT and maintains higher minimum SpO_2 values. Systematic reviews and meta-analyses particularly highlighted the reduced risk of hypoxemia, fewer procedural interruptions, and a decreased need for airway interventions (13, 20, 23, 25, 31, 32, 35, 37–39).

Randomized controlled trials (n = 13) demonstrated the superiority of HFNC across different populations and procedures, including bronchoscopy, ERCP, gastroscopy, and endoscopic submucosal dissection (17, 19, 21, 24, 26, 28–30, 33, 36, 40–42). Several studies (14, 22, 34) observed that HFNC and other methods, such as NIV or low-flow oxygen, showed comparable efficacy; however, HFNC more consistently provided greater stability of oxygenation in high-risk patients.

Retrospective and prospective studies further confirmed that HFNC significantly reduces the occurrence of desaturation and maintains stable SpO_2 during procedures (14–16, 18, 21, 22, 27, 34).

A concise summary of these findings is presented in Table 2, which consolidates the numerical outcomes and key methodological details of all included studies.

In conclusion, the findings indicate that HFNC is most effective in preventing hypoxemia during sedated endoscopic procedures, with optimal flow rates of 50–60 L/min, and is associated with a lower risk of complications and reduced need for procedural interruptions (13, 19, 42).

Discussion

This systematic review analyzed evidence from randomized trials, observational studies, and meta-analyses, all of which consistently show that HFNC significantly reduces hypoxemia and improves oxygenation compared with COT. The following discussion summarizes key findings by procedure type and patient population.

HFNC during gastrointestinal endoscopy

Sedation during upper gastrointestinal endoscopic procedures often causes hypoventilation and airway obstruction, increasing the risk of hypoxemia. Numerous studies confirm that the use of HFNC significantly reduces this risk compared with standard low-flow oxygen therapy. Meta-analyses consistently report a 60–75% relative risk reduction with HFNC use (20,39).

For instance, Thiruvenkatarajan et al. (2023) demonstrated a lower incidence of hypoxemia and higher minimum oxygen saturation with HFNC (20), while Zhang et al. (2022) additionally reported a reduced need for airway interventions in patients undergoing sedated gastrointestinal endoscopy (37). In practice, HFNC markedly decreases desaturation episodes and maintains higher oxygen saturation levels than COT (37). In practice, HFNC markedly decreases desaturation episodes and maintains higher oxygen saturation levels than COT.

These findings have been further supported by randomized trials. The multicenter ODEPHI RCT by Nay et al. (2021) showed that HFNC substantially reduced critical desaturation events in high-risk patients compared with standard oxygen therapy (30). Beyond reducing hypoxemia incidence, HFNC also decreases the need for procedural interruptions and airway maneuvers (20,30). Other studies confirmed that HFNC lowers the need for airway maneuvers and procedural interruptions, with the most pronounced benefit observed in preventing severe desaturation (9,11,22,30,37,40). The meta-analysis by Khanna et al. (2023) involving more than 3,000 patients also demonstrated significant reductions in desaturation incidents and procedure interruptions, together with higher minimum oxygen saturation (39). Although

Table 2. **Overview of included studies on the use of HFNC in the prevention of hypoxemia during endoscopic procedures (2015–2025)**

Authors, year	Type of study	Aim	Country	Key findings
Wei C, Ma SY, Jiang LL, Wang JW, Yuan LP, Wang YY, 2024 (13)	Meta-analysis of 12 RCTs (2004–2024), conducted using RevMan 5.4	To evaluate the clinical effects of HFNC compared with COT during gastrointestinal endoscopic procedures.	China	HFNC significantly reduced the incidence of hypoxemia (OR = 0.39, 95% CI: 0.29–0.53), increased minimum SpO_2 (MD = 4.07, 95% CI: 3.14–5.01), and decreased the need for airway interventions (OR = 0.16, 95% CI: 0.05–0.53). No significant differences were observed in SpO_2, hypercapnia, or procedure duration.
Saksitthichok B, Petnak T, So-ngem A, Boonsamgsuk V, 2019 (14)	Prospective randomized comparative study	To compare HFNC and NIV in maintaining oxygenation during flexible bronchoscopy	Thailand	HFNC and NIV showed similar efficacy in preventing hypoxemia, but NIV provided more stable oxygenation in patients with PaO_2 < 60 mmHg.
Arias-Sanchez PP, Ledesma G, Cobos J, Tirape H, Jaramillo B, Ruiz J, et al., 2023 (15)	Observational study	To compare HFNC and standard oxygen therapy during fiberoptic bronchoscopy	Ecuador	HFNC reduced the drop in SpO_2 during bronchoscopy (94% vs 90%, p = 0.04) and demonstrated less variability in oxygen saturation compared with standard therapy.
Chung SM, Choi JW, Lee YS, Choi JH, Oh JY, Min KH, et al., 2019 (16)	Retrospective observational study	To assess the effectiveness of HFNC during diagnostic and therapeutic bronchoscopy	South Korea	HFNC maintained stable SpO_2 (95–99.4%) during bronchoscopy, with no hypoxemic episodes during diagnostic procedures and improved oxygenation after therapeutic interventions.
Kim SH, Bang S, Lee K-Y, Park SW, Park JY, Lee HS, et al., 2021 (17)	Randomized controlled trial	To compare HFNC and COT during sedation in the prone position	South Korea	HFNC significantly reduced hypoxemia incidence and improved oxygenation compared with COT.
Lee S, Choi JW, Chung IS, Kim DK, Sim WS, Kim TJ, 2023 (18)	Retrospective observational study	To compare HFNC and COT during deep sedation for ESD	South Korea	HFNC significantly reduced hypoxemia (11.4% vs 35.2%) and the need for interventions but was associated with a higher rate of postprocedural radiological abnormalities.
Wang L, Zhang Y, Han D, Wei M, Zhang J, Cheng X, et al., 2025 (19)	Multicenter RCT	To evaluate the effect of HFNC in obese patients during GI endoscopy	China	HFNC significantly reduced hypoxemia (2% vs 21.2%), subclinical respiratory depression, and severe hypoxemia without increasing other adverse events.
Thiruvenkatarajan V, Sekhar V, Wong DT, Currie J, Van Wijk R, Ludbrook GL, 2023 (20)	Systematic review and meta-analysis	To evaluate HFNC versus COT during procedural sedation	Australia	HFNC reduced the risk of hypoxemia (RR 0.37), increased minimum SpO_2, and decreased the need for procedural interruptions.

Table 2. **Overview of included studies on the use of HFNC in the prevention of hypoxemia during endoscopic procedures (2015-2025)**

Authors, year	Type of study	Aim	Country	Key findings
Ayuse T, Kurata S, Mori T, Kuroda S, Ichinomiya T, Yano R, et al., 2023 (21)	Randomized comparative study	To assess the effect of HFNC on hypoxemia and hypercapnia during ERCP sedation	Japan	HFNC reduced hypoxemia and improved ventilation compared with a standard cannula.
Mohamed AM, Selima WZ, 2025 (22)	Prospective randomized study	To compare HFNC and COT during prolonged UGE in the ICU	Egypt	HFNC significantly reduced hypoxemia incidence (5.7% vs 51.4%) and improved safety.
Tao Y, Sun MY, Miao MR, Han YQ, Yang YT, Cong XH, Zhang JQ, 2022 (23)	Systematic review and meta-analysis	To evaluate the effectiveness of HFNC in endoscopic procedures	China	HFNC significantly reduced hypoxemia (RR 0.32), need for interventions, and procedural interruptions.
Teng WN, Ting CK, Wang YT, Hou MC, Chang WK, Tsou MY, et al., 2019 (24)	Randomized clinical trial	To evaluate the effectiveness of HFNC in endoscopic procedures	Taiwan	HFNC and MA reduced hypoxemia (18% and 12% fewer events, respectively) and the need for interventions.
Su CL, Chiang LL, Tam KW, Chen TT, Hu MC, 2021 (25)	Systematic review and meta-analysis of RCTs	To evaluate the effect of HFNC during bronchoscopy	USA	HFNC reduced hypoxemic events (RR 0.25) and increased minimum SpO- during procedures.
Zhaxi D, Ci D, Quan X, Laba C, 2024 (26)	Randomized controlled trial	To compare HFNC and COT during bronchoscopy in hypoxemic patients	China	HFNC reduced hypoxemia (9.3% vs 36.8%) and severe hypoxemia (0% vs 11.3%).
Luo XH, Xiang F, 2024 (27)	Retrospective study	To compare HFNC and COT during bronchoscopy in hypoxemic patients	China	HFNC significantly reduced SpO_2 < 90% events (3.8% vs 17.5%) and adverse effects (7.7% vs 20.1%).
Yin X, Xu W, Zhang J, Wang M, Chen Z, Liu S, Xu Y, Xu S, Ji D, Wang J, Gu W, 2024 (28)	Prospective randomized controlled trial	To compare HFNC and CNC in preventing hypoxemia in elderly patients during gastroscopy under sedation	China	HFNC significantly reduced hypoxemia (3.2% vs 22.6%, p = 0.001) and increased minimum SpO_2 compared with CNC.
Ben-Menachem E, McKenzie J, O'Sullivan C, Havryk AP, 2020 (29)	Randomized controlled trial (post-transplant patients)	To compare HFNC and LFNO during flexible bronchoscopy in lung transplant recipients	Australia	HFNC significantly reduced desaturation (SpO_2 < 94%: 43.2% vs 89.7%, p < 0.001) and procedural interruptions compared with LFNO.
Nay M-A, Fromont L, Eugene A, Marcueyz J-L, Mfam W-S, Baert O, Remerand F, Ravry C, Auvet A, Boulain T, 2021 (30)	Multicenter RCT (ODEPHI)	To evaluate the effect of HFNC on desaturation during gastrointestinal endoscopy under deep sedation	France	HFNC reduced the incidence of SpO_2 ≤ 92% (9.4% vs 33.5%, p < 0.001) and the need for airway maneuvers.

Table 2. **Overview of included studies on the use of HFNC in the prevention of hypoxemia during endoscopic procedures (2015-2025)**

Authors, year	Type of study	Aim	Country	Key findings
Doulberis M, Sampsonas F, Papaefthymiou A, Karamouzos V, Lagadinou M, Karampitsakos T, Stratakos G, Kuntzen T, Tzouvelekis A, 2022 (31)	Systematic review and meta-analysis	To evaluate the risk of hypoxemia with HFNC in gastrointestinal endoscopy compared with COT	Greece	HFNC reduced hypoxemia and procedural interruptions compared with COT.
Sampsonas F, Karamouzos V, Karampitsakos T, Papaioannou O, Katsaras M, Lagadinou M, Zarkadi E, Malakounidou E, Velissaris D, Stratakos G, Tzouvelekis A, 2022 (32)	Systematic review and meta-analysis (6 RCTs)	To evaluate HFNC versus LFNC during bronchoscopy	Greece	HFNC reduced hypoxemic episodes and procedural interruptions compared with LFNC.
Zhang W, Wang J-L, Fu S, Zhou J-M, Zhu Y-J, Cai S-N, Fang J, Xie K-J, Chen X-Z, 2022 (33)	Randomized controlled trial	To compare HFNC and face mask in patients at risk of hypoxemia during bronchoscopy	China	HFNC significantly reduced desaturation (4.6% vs 29.2%, $p < 0.001$) and the need for mask ventilation.
Sawase H, Ozawa E, Yano H, Ichinomiya T, et al., 2023 (34)	Prospective randomized single-center clinical trial (n = 75)	To compare HFNC with low-flow oxygen during ERCP under sedation for the prevention of hypercapnia and hypoxemia	Japan	HFNC at 40-60 L/min did not significantly reduce hypercapnia or hypoxemia compared with low-flow O_2 ($p > 0.05$).
Lee CC, Ju TR, Lai PC, Lin HT, Huang YT, 2022 (35)	Systematic review and meta-analysis of 8 RCTs	To evaluate the efficacy of HFNC in GI endoscopy compared with COT	Taiwan	HFNC reduced severe hypoxemia (RR 0.38, 95% CI: 0.20-0.74) but did not significantly affect overall hypoxemia incidence.
Zhang W, Yin H, Xu Y, Fang Z, et al., 2022 (36)	Prospective randomized single-blind trial (n = 369)	To compare HFNC with different FiO_2 levels (50% and 100%) and standard cannula during gastroscopy in elderly patients	China	HFNC significantly reduced hypoxemia compared with COT ($p < 0.05$); no difference between FiO_2 50% and 100%.
Zhang YX, He XX, Chen YP, Yang S, 2022 (37)	Systematic review and meta-analysis (7 RCTs, n = 2998)	To evaluate the efficacy of HFNC in sedated gastrointestinal endoscopy	China	HFNC reduced hypoxemia (OR 0.24, 95% CI: 0.09-0.64) and airway intervention requirements (OR 0.15, 95% CI: 0.03-0.69).
Wei C, Ma SY, Wang JW, Yang N, et al., 2024 (38)	Systematic review and meta-analysis of 12 studies (n = 1631)	To compare HFNC with other methods during bronchoscopy	China	HFNC significantly reduced hypoxemia (RR 0.27, 95% CI: 0.18-0.41) and improved minimum SpO_2.

Table 2. **Overview of included studies on the use of HFNC in the prevention of hypoxemia during endoscopic procedures (2015–2025)**

Authors, year	Type of study	Aim	Country	Key findings
Khanna P, Haritha D, Das A, Sarkar S, Roy A, 2023 (39)	Systematic review and meta-analysis (9 studies, n = 3294)	To assess the utility of HFNC in upper GI endoscopy under sedation	India	HFNC reduced desaturation (OR 0.23, 95% CI: 0.11–0.48) and procedural interruptions (OR 0.11, 95% CI: 0.02–0.60).
Wang R, Li H-C, Li X-Y, Tang X, Chu H-W, Yuan X, Tong Z-H, Sun B, 2021 (40)	Prospective randomized controlled trial	To compare modified HFNC and COT during bronchoscopy in reducing SpO_2 < 90%	China	HFNC significantly reduced hypoxemia (12.5% vs 28.8%, p < 0.001) and maintained higher SpO_2 during and after bronchoscopy.
Feng Y, Chen Z, Wang J, 2024 (41)	Randomized controlled trial	To investigate the effect of transnasal HFNC therapy on gag reflex and oxygenation in elderly patients during fiberoptic bronchoscopy	China	HFNC improved SpO- , reduced hypoxemia and gag reflex, with no significant impact on hemodynamics.
Zhang W, Yuan X, Shen Y, Wang J, Xie K, Chen X, 2024 (42)	Prospective randomized controlled trial	To determine the optimal HFNC flow rate for preventing desaturation during bronchoscopy	China	The optimal HFNC flow rate for preventing desaturation in 95% of patients was 43.2 L/min (95% CI: 36.4–56.0); 50–60 L/min is recommended.

Lee et al. (2016) did not find a significant difference in overall hypoxemia rates, their results indicated that HFNC reduces the risk of severe hypoxemia compared with COT (8).

Collectively, the evidence shows that HFNC enhances respiratory safety during sedated gastrointestinal endoscopy, leading to fewer and less severe desaturation events and reducing the need for airway interventions.

HFNC during bronchoscopy

Similar benefits of HFNC have been reported during sedated bronchoscopy. Patients, especially those with impaired lung function, are highly susceptible to hypoxemia due to sedation and airway obstruction. Several studies indicate that HFNC is more effective than COT in maintaining oxygenation in this setting. The systematic review and meta-analysis by Su et al. (2021), including five RCTs, showed that HFNC significantly reduced hypoxemic events and increased minimum SpO_2 compared with COT (25). In practice, this means patients receiving HFNC were less likely to reach critically low saturation levels during the procedure.

HFNC has also been compared with other oxygenation techniques. The RCT by Saksitthichok et al. (2019) found comparable protection against desaturation between HFNC and NIV in high-risk hypoxemic patients, with no significant difference in lowest SpO_2 (14). Only in the most severely hypoxemic subgroup (baseline PaO_2 < 60 mmHg) did NIV provide slightly more stable oxygenation, suggesting a marginal advantage of mechanical support in that population.

Observational studies (15,16) further confirmed that HFNC maintains stable SpO_2 levels, often above 95%, without significant hypoxemia or procedural interruptions. Overall, HFNC improves oxygenation reserve, allowing safer and more continuous bronchoscopy with fewer complications related to oxygen deficiency.

High-risk patient populations and specific procedural conditions

The advantages of HFNC are particularly evident in vulnerable patient populations and specific procedural conditions. In a recent multicenter RCT (2025) in obese patients (BMI ≥ 28) undergoing sedated endoscopy, HFNC markedly reduced the incidence of hypoxemia, from 21% with COT to only 2%. Subclinical respiratory depression (SpO_2 90–94%) also decreased from 36% to 5%, while severe hypoxemia was virtually eliminated (0% vs 4%) (19). These results highlight the importance of HFNC in obese patients, who desaturate more rapidly due to obstructive physiology.

Similarly, in elderly patients and those with comorbidities, HFNC has shown clear superiority over COT. Yin et al. (2024) found that among geriatric patients (>65 years) undergoing sedated gastroscopy, hypoxemia occurred in only 3% with HFNC versus 23% with standard therapy, with higher minimum SpO_2 values (28). This suggests that older patients, often more sensitive to sedatives, derive substantial benefit from HFNC.

The method has proven effective even under extreme environmental conditions. At high altitude (3600 m), HFNC significantly reduced hypoxemia incidence during endoscopic procedures (9% vs 37% with COT), completely preventing severe desaturation (26). This demonstrates its potential beyond conventional hospital settings, including environments with baseline hypoxemia caused by hypobaric conditions.

In transplant populations with reduced respiratory reserve, HFNC has also shown benefit. In a randomized trial in post-lung transplant patients, Ben-Menachem et al. (2020) reported that HFNC nearly halved desaturation events (43% vs 90%) and reduced procedural interruptions compared with COT (29). Collectively, evidence confirms that high-risk populations, including obese, elderly, hypoxemic, and post-transplant patients, experience the greatest clinical advantage from HFNC.

Comparison of HFNC with other methods of oxygenation support

HFNC has become a valuable tool for preventing hypoxemia during invasive procedures under sedation, yet its limitations and comparison with alternative strategies remain relevant. Compared with non-invasive ventilation (NIV), HFNC provides similar oxygenation support in most patients (14). Its main advantages are simplicity, comfort, and patient preference for nasal cannula over pressurized masks (43). However, in severely compromised patients, NIV can offer stronger positive pressure and ventilatory assistance, outperforming HFNC in preventing profound hypoxemia or hypercapnia (44).

Not all studies have reported uniform benefits. In the trial by Sawase et al. (2023) during ERCP under moderate sedation, HFNC was applied with room air only (FiO_2 21%, 40–60 L/min) and compared with low-flow O_2. Under these conditions, HFNC did not significantly reduce hypoxemia or hypercapnia compared with COT (8% vs 5%; p = 0.674) (34). These results suggest that the effectiveness of HFNC depends on the delivered FiO_2 and that benefits are more pronounced when oxygen-enriched flow (40–100% O_2) is used, as is typical in clinical practice.

Regarding safety, most studies have not identified an increased rate of adverse events such as arrhythmias, aspiration, or post-procedural complications (19,29,39,45). Moreover, Lee et al. (2016) reported that HFNC significantly reduced the need to escalate to more invasive support methods, including mask ventilation or NIV, in three of four analyzed trials (46). HFNC is generally safe and well tolerated, with minimal risk of mucosal dryness due to heated and humidified gas. Proper device setup, flow adjustment, and cannula fixation are essential for optimal performance.

Cumulative evidence supports HFNC as an effective standard for sedated endoscopic procedures in patients at increased respiratory risk (20). Its capacity to reduce hypoxemia and emergent airway interventions represents a major advance in procedural safety (30). Consequently, many centers have incorporated HFNC into routine practice, especially for elderly, obese, and pulmonary patients. Future studies should refine application protocols, including optimal flow rates, FiO_2 levels, and duration. Based on current data, HFNC makes a substantial contribution to respiratory safety and deserves wider clinical implementation (20).

Limitations

This systematic review has several methodological limitations. First, the literature search was restricted to three databases (PubMed, Web of Science, and Scopus) and to articles available in English which may

have introduced language and publication bias. Second, most of the included studies were conducted in Asian countries, particularly in China, which may affect the generalizability of the findings due to potential differences in sedation protocols, clinical practice, and population characteristics. Third, heterogeneity across studies, including variable definitions of hypoxemia, different saturation thresholds and inconsistent flow and FiO_2 settings, makes direct comparison of results and meta-analytic conclusions more challenging. Finally, several of the included studies analyzed relatively small patient populations which may limit the statistical power and precision of the estimated effects of HFNC.

Conclusion

The analyzed studies clearly confirm that HFNC is a more effective method than COT for the prevention of hypoxemia during sedated endoscopic procedures. In addition to reducing the risk of desaturation, HFNC provides better oxygenation and decreases the need for additional airway interventions. Optimal flow rates of 50–60 L/min have proven to be the most effective and well tolerated.

From a nursing perspective, understanding the principles, indications, and clinical application of HFNC can significantly improve peri-procedural patient management, particularly in high-risk populations. Integrating HFNC protocols into routine nursing practice enhances respiratory safety, supports timely recognition of hypoxemia, and reduces the need for emergency interventions.

Future research should aim to define standardized protocols for HFNC use, compare different flow and FiO_2 settings, and evaluate long-term outcomes and cost effectiveness across diverse clinical environments. Further interdisciplinary studies are encouraged to assess nursing-led education, monitoring strategies, and the role of nurses in optimizing HFNC implementation and patient outcomes.

Author Contributions

Conceptualization (VJ, JP, MV, TMT, MS); Data Curation (VJ), Formal Analysis (VJ, JP, MS); Writing – Original Draft (VJ), Writing – Review & Editing (VJ, JP, MV, TMT, MS). All authors reviewed and approved the final version of the manuscript.

Conflict of Interest

The authors declare no conflicts of interest.

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