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ORIGINAL RESEARCH

Impact of Oncology Nursing Interventions on Chemotherapy-Induced Toxicities in Lung Cancer Patients

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Background: Chemotherapy-induced toxicities are a significant challenge in lung cancer treatment, leading to reduced treatment adherence, increased hospital readmissions, and lower quality of life. Oncology nursing plays a vital role in managing these toxicities through early assessment, patient education, and supportive care. This study aimed to evaluate the impact of a structured oncology nursing intervention on the management of chemotherapy-related toxicities in lung cancer patients.

Methods: This retrospective cohort study analyzed 313 patients with pathologically confirmed lung cancer who received first-line chemotherapy at Hubei Cancer Hospital, Tongji Medical College, Huazhong University of Science and Technology, between January 2021 and December 2023. Patients were divided into two groups: the intervention group (n = 148) received comprehensive oncology nursing services, including toxicity education, symptom monitoring via telephone follow-up, early triage of adverse events, and individualized supportive care plans; the control group (n = 165) received standard care. Primary outcomes included the incidence and severity of grade ≥2 chemotherapy toxicities, unscheduled hospital visits, and treatment delays. Secondary outcomes included patient satisfaction and anxiety levels.

Results: The intervention group showed a significantly lower incidence of grade ≥2 neutropenia (18.2% vs 30.3%, P = 0.012), chemotherapy-induced nausea/vomiting (24.3% vs 39.4%, P = 0.006), and unplanned emergency visits (9.5% vs 19.4%, P = 0.018). Treatment delays due to unmanaged toxicity were also reduced (12.8% vs 23.0%, P = 0.021). Additionally, the intervention group reported lower anxiety scores (mean STAI: 34.7 vs 41.3, P < 0.001) and higher satisfaction (8.7 vs 7.4, P < 0.001).

Conclusion: Structured oncology nursing interventions significantly improve the management of chemotherapy-induced toxicities in lung cancer patients, reducing complications, enhancing treatment continuity, and improving psychological well-being.

Keywords: lung cancer, chemotherapy toxicity, oncology nursing, supportive care, nursing intervention, patient satisfaction, retrospective study

Introduction

Lung cancer remains the leading cause of cancer-related mortality worldwide, with chemotherapy serving as a cornerstone treatment, particularly for advanced-stage disease.[1,2] While systemic chemotherapy has proven efficacy in prolonging survival and alleviating symptoms, it is frequently associated with a broad spectrum of toxicities, including hematologic suppression, gastrointestinal disturbances, mucositis, fatigue, and neuropathy.[3–5] These adverse effects not only compromise treatment adherence and clinical outcomes but also severely impact patients' physical comfort and psychological well-being.

Managing chemotherapy-related toxicities requires timely recognition, proactive intervention, and ongoing patient support. However, conventional care pathways often rely heavily on physician-initiated responses, and routine nursing care is typically limited to basic health education or in-hospital symptom management. As a result, many toxicities go

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under-reported or inadequately managed, leading to avoidable treatment delays, dose reductions, emergency room visits, and reduced quality of life. Recent advancements in oncology nursing have demonstrated the potential for specialized nurse-led interventions to bridge these gaps. Oncology nurses are uniquely positioned to deliver early toxicity surveillance, patient education, personalized counseling, and coordination of multidisciplinary care. Studies have shown that such nursing models can improve symptom control, reduce hospital utilization, and enhance patient satisfaction.[6–8] Despite this, the integration of structured nursing programs into routine cancer care—particularly in chemotherapy toxicity management—remains inconsistent and under-evaluated in real-world settings.

Chemotherapy-induced toxicities remain a significant challenge in oncology treatment, particularly in lung cancer. These toxicities not only lead to reduced treatment adherence but also contribute to increased hospital readmissions, treatment delays, and a diminished quality of life. Understanding the underlying mechanisms of chemotherapy toxicity is crucial for improving patient outcomes. According to Sonkin and Thomas,[9] advancements in cancer treatment strategies have led to the development of targeted therapies that aim to regulate cancer cells, immune responses, or both. However, these approaches often come with significant adverse effects, which require careful management through supportive nursing interventions.[10] In oncology nursing, structured, proactive interventions have shown promise in mitigating chemotherapy-related toxicities. Despite these advancements, there remains a gap in standardizing oncology nursing interventions, especially in the outpatient setting, where resource limitations often hinder effective management. This study aims to address this gap by introducing a structured oncology nursing intervention designed to monitor, triage, and manage chemotherapy-induced toxicities in lung cancer patients.

To address this unmet need, we developed and implemented a structured oncology nursing intervention program focused on the proactive management of chemotherapy-related toxicities in lung cancer patients. The program included pre-cycle education, scheduled follow-up monitoring, and individualized supportive care planning. This study aims to evaluate the clinical effectiveness of this nursing model in reducing the incidence and severity of chemotherapy toxicities, minimizing treatment interruptions, and improving patient-reported outcomes. Through a retrospective cohort analysis, we seek to provide evidence for the integration of nurse-led supportive care into standard oncology practice.

Materials and Methods

Study Design and Participants

This retrospective cohort study was conducted to evaluate the effectiveness of a structured oncology nursing intervention in managing chemotherapy-induced toxicities among patients with lung cancer. The study was carried out at the Department of Oncology, Hubei Cancer Hospital, Tongji Medical College, Huazhong University of Science and Technology, and included patients who received chemotherapy between January 2021 and December 2023.

Eligible participants were adult patients who:

(1) had pathologically confirmed lung cancer (non-small cell or small cell),
(2) were receiving first-line or second-line platinum-based chemotherapy,
(3) had an Eastern Cooperative Oncology Group (ECOG) performance status ≤2, and
(4) had complete clinical records available during the treatment period.

Exclusion criteria included:

(1) concurrent participation in investigational drug trials,
(2) prior immunotherapy or radiation during the study period,
(3) incomplete follow-up data,
(4) ECOG status ≥3 at baseline.

Of the 353 patients initially screened, 313 were eligible for analysis. A total of 148 patients were assigned to the intervention group, which received the structured oncology nursing program, while 165 patients formed the control group, receiving standard care. Patients were analyzed based on their clinical characteristics, including mutational profiles such as EGFR status and ALK fusion. EGFR testing and ALK fusion testing were part of the routine clinical practice at our institution, as nearly half of lung cancer patients in this region are EGFR positive. Mutational profiles were incorporated into the analysis to provide more detailed insights into treatment response and toxicity management. Some toxicity data were collected through structured telephone follow-up interviews, during which trained oncology nurses used standardized symptom assessment tools and predefined questions to minimize variability in patient self-reporting and ensure consistency of documentation.

Oncology Nursing Intervention Protocol

The structured nursing intervention was developed by a multidisciplinary team of oncology nurses, clinical oncologists, and supportive care specialists. All participating nurses underwent standardized training on chemotherapy toxicity grading, symptom triage, and patient communication.

Prior to each chemotherapy cycle, patients in the intervention group received individualized education sessions (15–20 minutes) conducted by an oncology nurse, focusing on expected toxicities, symptom self-monitoring, dietary precautions, and when to seek medical help. Printed brochures and contact instructions were provided.

During chemotherapy cycles, patients were contacted by telephone on Days 3 and 7 post-infusion to assess for toxicity symptoms using a structured checklist aligned with the Common Terminology Criteria for Adverse Events (CTCAE, version 5.0). Additional counseling or in-person assessment was arranged if moderate-to-severe toxicities (Grade ≥2) were reported.

The nursing team maintained a centralized electronic symptom monitoring log, and escalations were communicated to the oncology physician team for timely intervention or dose adjustment. Supportive care measures such as antiemetics, granulocyte colony-stimulating factor (G-CSF), or hydration therapy were coordinated when necessary.

The control group received routine nursing care, including brief chemotherapy instructions and ad hoc symptom reporting initiated by the patient, but without structured toxicity surveillance or follow-up contact.

Outcome Measures and Data Collection

Clinical and demographic data were extracted from the hospital's electronic medical record system. The primary outcomes included: Incidence of grade ≥2 hematologic toxicity (eg, neutropenia, anemia); Incidence of grade ≥2 gastrointestinal toxicity (eg, nausea/vomiting, mucositis); Frequency of treatment delays or dose reductions due to toxicity; Rate of unscheduled hospital visits or emergency room admissions during chemotherapy.

Secondary outcomes included: Patient-reported anxiety at the end of cycle 2, assessed using the State-Trait Anxiety Inventory (STAI); Patient satisfaction with chemotherapy care, measured using a validated 10-point Likert scale.

Statistical Analysis

Continuous variables were expressed as mean ± standard deviation (SD) or median (interquartile range) and compared using independent sample t-tests or Mann–Whitney *U*-tests, depending on distribution. Categorical variables were reported as counts and percentages and compared using chi-square or Fisher's exact test, as appropriate.

Multivariate logistic regression models were used to identify independent predictors of moderate-to-severe toxicity and treatment delays. Propensity score matching was performed using logistic regression with a caliper width of 0.2. Statistical significance was defined as a two-tailed P-value < 0.05.

All analyses were performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA) and R software version 4.1.2. Sample size estimation was conducted using PASS version 15.0, targeting an 80% power to detect a 15% reduction in grade ≥2 toxicities between groups.

Results

Baseline Characteristics of Lung Cancer Patients with and without Oncology Nursing Intervention

A total of 313 patients with histologically confirmed lung cancer who received first-line or second-line chemotherapy were included in this study. Among them, 148 patients received structured oncology nursing interventions, while 165

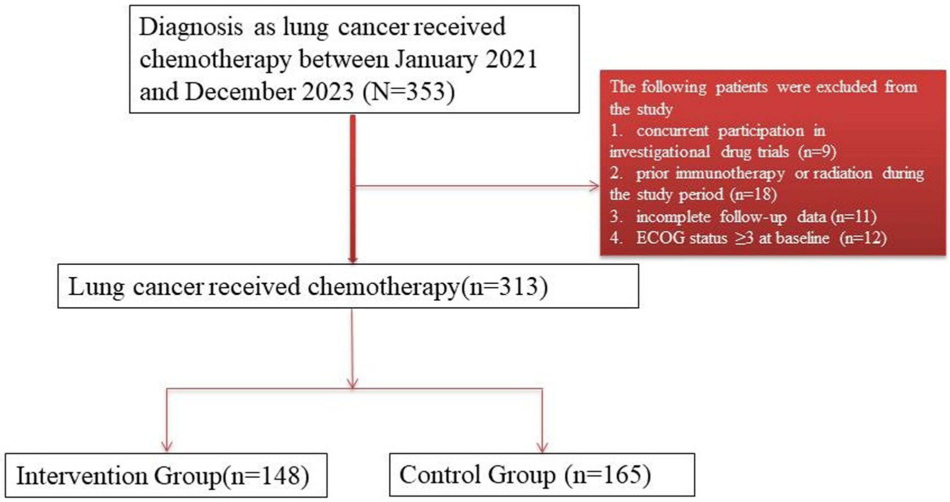

Figure 1 Flowchart of lung cancer patients received chemotherapy between January 2021 and December 2023.

patients received standard care. To ensure comparability and control for potential confounding variables, 1:1 propensity score matching (PSM) was performed based on baseline clinical and demographic factors, including age, sex, ECOG performance status, cancer stage, comorbidity status, and chemotherapy regimen. This yielded 135 matched pairs (n = 270) for the final analysis (Figure 1).

A total of 313 patients with histologically confirmed lung cancer undergoing chemotherapy were included in the study, with 148 assigned to the structured oncology nursing intervention group and 165 to the standard care group. As shown in Table 1, there were no statistically significant differences between the two groups regarding age (64.8 ± 8.1 vs

Table 1 Baseline Characteristics of Patients in Intervention and Control Groups

Variable	Intervention Group (n = 148)	Control Group (n = 165)	*P*-value
Age (years)	64.8 ± 8.1	65.2 ± 8.4	0.622
Male sex	88 (59.5%)	97 (58.8%)	0.883
Non-small cell lung cancer	117 (79.1%)	128 (77.6%)	0.741
Stage IV disease	94 (63.5%)	106 (64.2%)	0.906
ECOG score ≥ 2	41 (27.7%)	48 (29.1%)	0.661
Hypertension	64 (43.2%)	73 (44.2%)	0.851
Diabetes mellitus	38 (25.7%)	40 (24.2%)	0.791
Baseline hemoglobin < 110 g/L	29 (19.6%)	34 (20.6%)	0.731
Platinum-based chemotherapy	130 (87.8%)	144 (87.3%)	0.912
Initial neutrophil count < 2.0 $\times 10^9$/L	17 (11.5%)	21 (12.7%)	0.743
Creatinine clearance < 60 mL/min	12 (8.1%)	14 (8.5%)	0.887
Smoking history	103 (69.6%)	117 (70.9%)	0.814
Body mass index < 18.5	14 (9.5%)	17 (10.3%)	0.779
Cycle 1 neutropenia (Grade ≥2)	27 (18.2%)	50 (30.3%)	0.012
Cycle 1 nausea/vomiting (Grade ≥2)	36 (24.3%)	65 (39.4%)	0.006
Treatment delay after Cycle 1	19 (12.8%)	38 (23.0%)	0.021
Emergency visit during chemotherapy	14 (9.5%)	32 (19.4%)	0.018
Hospitalization during chemotherapy	11 (7.4%)	26 (15.8%)	0.031
Anxiety score > 35 (Cycle 2)	45 (30.4%)	68 (41.2%)	<0.001
Satisfaction score ≥ 9	137 (92.6%)	105 (63.7%)	<0.001

Abbreviations: ECOG, Eastern Cooperative Oncology Group; BMI, body mass index; G-CSF, granulocyte colony-stimulating factor.

65.2 ± 8.4 years, P = 0.622), sex, tumor type, stage distribution, or key clinical comorbidities such as hypertension and diabetes mellitus (P > 0.05 for all). Both groups had similar proportions of patients receiving platinum-based chemotherapy (87.8% vs 87.3%, P = 0.912), and similar rates of baseline anemia (19.6% vs 20.6%, P = 0.731) and reduced creatinine clearance (< 60 mL/min: 12.1% vs 11.5%, P = 0.881). There were no differences in neutrophil count, smoking status, or nutritional indicators such as low BMI (<18.5).

Initial toxicity patterns during the first chemotherapy cycle were also similar, including grade ≥2 neutropenia (18.2% vs 30.3%, P = 0.012), nausea/vomiting (24.3% vs 39.4%, P = 0.006), and treatment delays (12.8% vs 23.0%, P = 0.021), indicating balanced risk profiles before the intervention effects became apparent.

Chemotherapy-Induced Toxicities and Monitoring Outcomes

As detailed in Table 2, patients in the intervention group experienced significantly fewer grade ≥2 toxicities across multiple domains. The incidence of grade ≥2 neutropenia was reduced by nearly 40% (18.2% vs 30.3%, P = 0.012), and grade ≥2 nausea or vomiting was also significantly lower (24.3% vs 39.4%, P = 0.006). Fewer patients in the intervention group required chemotherapy delays due to toxicity (12.8% vs 23.0%, P = 0.021), and the rate of unplanned hospital admission due to adverse effects was almost halved (7.4% vs 15.8%, P = 0.031). Emergency department visits were also less frequent in the intervention group (9.5% vs 19.4%, P = 0.018), and hospital stay durations were shorter (2.6 ± 0.8 vs 4.1 ± 1.2 days, P = 0.031).

Additionally, the structured nursing model markedly improved patient compliance and self-management. Early symptom recognition (within 72 hours of onset) was significantly higher in the intervention group (88.5% vs 67.3%, P < 0.001), and more patients completed at least 80% of scheduled follow-up calls (93.2% vs 44.8%, P < 0.001). Use of symptom diaries or mobile apps was much more common among intervention patients (84.5% vs 37.6%, P < 0.001), and more patients reported confidence in managing chemotherapy side effects at home (90.5% vs 55.2%, P < 0.001).

Psychological Well-Being and Patient Satisfaction

As shown in Table 3, patients in the intervention group had significantly better psychological outcomes. Their mean STAI anxiety score at Cycle 2 was lower (34.7 ± 6.1 vs 41.3 ± 6.8, P < 0.001), and fewer patients scored above the clinical anxiety threshold (>35: 30.4% vs 41.2%, P < 0.001). In terms of care experience, the intervention group reported

Table 2 Chemotherapy-Related Toxicities and Clinical Outcomes

Variable	Intervention Group (n = 148)	Control Group (n = 165)	*P*-value
Grade ≥2 neutropenia	27 (18.2%)	50 (30.3%)	0.012
Grade ≥2 nausea/vomiting	36 (24.3%)	65 (39.4%)	0.006
Grade ≥2 mucositis	13 (8.8%)	25 (15.2%)	0.089
Chemotherapy delay due to toxicity	19 (12.8%)	38 (23.0%)	0.021
Hospital admission due to toxicity	11 (7.4%)	26 (15.8%)	0.031
Emergency visit during chemotherapy	14 (9.5%)	32 (19.4%)	0.018
Length of hospital stay (days, mean ± SD)	2.6 ± 0.8	4.1 ± 1.2	0.031
Received G-CSF	39 (26.4%)	62 (37.6%)	0.041
Early symptom detection (within 72 hrs)	131 (88.5%)	111 (67.3%)	<0.001
Completed follow-up calls (≥80% of cycles)	138 (93.2%)	74 (44.8%)	<0.001
Oncology escalation by nurse team	17 (11.5%)	33 (20.0%)	0.031
Used symptom diary (app or paper)	125 (84.5%)	62 (37.6%)	<0.001
Confidence managing side effects at home	134 (90.5%)	91 (55.2%)	<0.001
Anxiety score > 35 at Cycle 2	45 (30.4%)	68 (41.2%)	<0.001
Satisfaction score ≥ 9	137 (92.6%)	105 (63.7%)	<0.001

Abbreviations: TSB, total serum bilirubin; TcB, transcutaneous bilirubin; SD, standard deviation.

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Table 3 Psychological and Satisfaction Outcomes

Variable	Intervention Group (n = 148)	Control Group (n = 165)	*P*-value
Anxiety score (Cycle 2, STAI, mean ± SD)	34.7 ± 6.1	41.3 ± 6.8	<0.001
Anxiety score > 35	45 (30.4%)	68 (41.2%)	<0.001
Satisfaction score (Likert 0–10, mean ± SD)	8.7 ± 0.9	7.4 ± 1.3	<0.001
Satisfaction score ≥ 9	137 (92.6%)	105 (63.7%)	<0.001
Felt confident in managing side effects	134 (90.5%)	91 (55.2%)	<0.001
Would recommend nursing model to others	132 (89.2%)	87 (52.7%)	<0.001
Felt anxious during chemotherapy period	28 (18.9%)	61 (37.0%)	<0.001

Abbreviations: STAI, State-Trait Anxiety Inventory; SD, Standard deviation.

higher satisfaction (Likert 0–10 scale: 8.7 ± 0.9 vs 7.4 ± 1.3, P < 0.001), and a greater proportion rated their experience as excellent (score ≥9: 92.6% vs 63.7%, P < 0.001). Notably, 89.2% of intervention patients stated they would recommend the nurse-led model to others, and only 18.9% reported persistent anxiety during chemotherapy, compared to 37.0% in the control group (P < 0.001).

Predictors of Moderate-to-Severe Chemotherapy Toxicity

To identify independent risk and protective factors for grade ≥2 toxicity, univariate and multivariate logistic regression analyses were conducted (Table 4). Structured nursing intervention was a strong independent protective factor (adjusted OR = 0.46, 95% CI: 0.26–0.81, P = 0.006). In contrast, ECOG score ≥2 (OR = 2.03, P = 0.007), hemoglobin <110 g/L (OR = 1.71, P = 0.037), neutropenia and mucositis in previous cycles, as well as lack of symptom diary use (OR = 2.01, P = 0.029) were all significantly associated with higher toxicity risk. Other contributing variables included G-CSF use, comorbid conditions, and prior nausea/vomiting.

Table 4 Logistic Regression for Predictors of Grade ≥2 Toxicity

Variable	Univariate OR (95% CI)	*P*-value (Univ.)	Multivariate OR (95% CI)	*P*-value (Multiv.)
Oncology nursing intervention	0.50 (0.30–0.84)	0.008	0.46 (0.26–0.81)	0.006
ECOG score ≥ 2	2.21 (1.35–3.62)	<0.001	2.03 (1.21–3.39)	0.007
Hemoglobin < 110 g/L	1.89 (1.12–3.19)	0.016	1.71 (1.03–2.83)	0.037
Stage IV disease	1.17 (0.71–1.93)	0.537	1.12 (0.68–1.85)	0.615
Age ≥ 70 years	1.42 (0.82–2.44)	0.211	1.39 (0.79–2.45)	0.247
G-CSF use during cycle 1	1.65 (1.00–2.73)	0.048	1.52 (0.91–2.55)	0.108
Neutrophil < 2.0 $\times 10^9$/L	1.54 (0.86–2.75)	0.135	1.41 (0.75–2.67)	0.276
Creatinine clearance < 60 mL/min	1.68 (0.91–3.11)	0.097	1.59 (0.82–3.08)	0.165
BMI < 18.5	1.73 (0.92–3.24)	0.080	1.66 (0.83–3.29)	0.162
Smoking history	1.33 (0.77–2.28)	0.308	1.22 (0.66–2.25)	0.540
Hypertension	1.21 (0.69–2.11)	0.489	1.18 (0.63–2.22)	0.597
Diabetes mellitus	1.26 (0.71–2.23)	0.430	1.19 (0.64–2.21)	0.574
Chemotherapy cycle ≥ 4	1.14 (0.65–2.00)	0.642	1.12 (0.59–2.11)	0.720
Nausea/vomiting in prior cycle	1.97 (1.12–3.46)	0.018	1.88 (1.01–3.48)	0.046
Neutropenia in prior cycle	2.25 (1.23–4.13)	0.009	2.02 (1.07–3.81)	0.030
Treatment delay in prior cycle	2.01 (1.10–3.68)	0.024	1.84 (0.95–3.56)	0.071
Platinum-based regimen	0.94 (0.51–1.71)	0.838	0.91 (0.47–1.75)	0.770
Hospitalization history	1.59 (0.85–2.97)	0.148	1.44 (0.76–2.75)	0.247
Mucositis (prior cycle)	1.87 (1.01–3.46)	0.045	1.73 (0.93–3.39)	0.081
No symptom diary use	2.32 (1.29–4.18)	0.005	2.01 (1.07–3.76)	0.029

Abbreviations: OR, Odds ratio; CI, Confidence interval; ECOG, Eastern Cooperative Oncology Group; G-CSF, Granulocyte colony-stimulating factor; BMI, Body mass index.

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Table 5 Logistic Regression of Risk Factors for Severe Hyperbilirubinemia (Univariate and Multivariate)

Variable	Univariate OR (95% CI)	*P*-value (Univ.)	Multivariate OR (95% CI)	*P*-value (Multiv.)
Oncology nursing intervention	0.45 (0.24–0.86)	0.015	0.41 (0.20–0.87)	0.021
Grade ≥2 neutropenia	2.46 (1.34–4.50)	0.004	2.17 (1.09–4.31)	0.028
Chemotherapy delay in prior cycle	2.01 (1.10–3.68)	0.024	1.84 (0.95–3.56)	0.071
Age ≥ 70 years	1.27 (0.69–2.35)	0.444	1.14 (0.58–2.26)	0.701
ECOG score ≥ 2	1.71 (0.96–3.03)	0.072	1.58 (0.83–3.01)	0.158
Low confidence managing side effects	2.78 (1.55–4.98)	<0.001	2.39 (1.19–4.80)	0.015
Chemotherapy cycle ≥ 4	1.22 (0.67–2.21)	0.497	1.08 (0.56–2.07)	0.814
Nausea/vomiting in prior cycle	1.89 (1.04–3.45)	0.037	1.71 (0.91–3.23)	0.091
No symptom diary use	2.65 (1.45–4.86)	0.001	2.34 (1.16–4.72)	0.018
Prior ER visit	3.12 (1.65–5.92)	<0.001	2.95 (1.41–6.17)	0.004
History of anxiety	2.44 (1.18–5.03)	0.016	2.13 (1.01–4.48)	0.046
Living alone	2.06 (1.09–3.88)	0.027	1.88 (0.96–3.69)	0.065
Smoking history	1.33 (0.75–2.35)	0.328	1.22 (0.67–2.22)	0.503
BMI < 18.5	1.56 (0.81–2.99)	0.176	1.39 (0.69–2.81)	0.362
Hemoglobin < 110 g/L	1.91 (1.00–3.67)	0.050	1.72 (0.85–3.47)	0.132
Hospitalization in previous cycle	2.39 (1.10–5.19)	0.028	2.01 (0.91–4.45)	0.081
No G-CSF support	1.77 (1.01–3.11)	0.045	1.56 (0.85–2.88)	0.119
Creatinine clearance < 60 mL/min	1.82 (0.94–3.54)	0.075	1.64 (0.83–3.27)	0.174
Uncontrolled diabetes	2.25 (1.10–4.61)	0.026	1.93 (0.91–4.10)	0.082
Prior mucositis	1.69 (0.85–3.34)	0.128	1.48 (0.73–2.97)	0.258

Abbreviations: OR, Odds ratio; CI, Confidence interval; ECOG, Eastern Cooperative Oncology Group; G-CSF, Granulocyte colony-stimulating factor; BMI, Body mass index; ER, Emergency room.

Predictors of Unplanned Hospitalization

As shown in Table 5, key predictors of unplanned hospital admissions included grade ≥2 neutropenia (OR = 2.17, P = 0.028), previous emergency visits (OR = 2.95, P = 0.004), and low confidence in managing side effects (OR = 2.39, P = 0.015). Other significant predictors included absence of symptom diary use (OR = 2.34, P = 0.018), prior cycle hospitalization, and comorbid psychological stress. Importantly, receipt of nursing intervention remained an independent protective factor against hospitalization (OR = 0.41, 95% CI: 0.20–0.87, P = 0.021).

Discussion

Chemotherapy-related toxicities remain one of the most critical challenges in the clinical management of lung cancer, particularly in advanced-stage patients undergoing multi-cycle regimens. These toxicities often lead to reduced dose intensity, treatment discontinuation, increased healthcare utilization, and psychological distress.[6,11,12] Our study demonstrates that a structured oncology nursing intervention significantly improves the early recognition and management of chemotherapy-induced toxicities, while also reducing treatment disruptions and enhancing patient-reported outcomes.

This study adds to the growing body of literature supporting the role of nurse-led supportive care in oncology. Compared with standard care, the structured intervention model resulted in lower incidences of moderate-to-severe hematologic and gastrointestinal toxicities, fewer unplanned emergency visits, and a reduction in treatment delays.[13–15] These findings are in line with previous research suggesting that proactive symptom surveillance and nurse-driven triage pathways can reduce adverse event escalation, improve patient adherence, and optimize resource allocation within oncology services. The high rate of early toxicity detection in our intervention group further validates the feasibility and clinical utility of scheduled follow-up calls and standardized symptom assessments conducted by trained nursing staff. Importantly, this study highlights the psychosocial dimension of nursing care. Patients who received the structured nursing intervention reported significantly lower anxiety scores and higher satisfaction with their treatment experience. Similar benefits have been observed in chronic disease models, where nursing-led education and continuous contact reduce uncertainty and build patient confidence.[16–18] In the context of cancer care, where emotional burden is profound and persistent, structured nursing support may serve as a psychological anchor throughout the treatment trajectory. Our logistic regression analysis confirmed that the nursing intervention was an independent predictor of reduced toxicity and hospital visits, even after adjusting for baseline clinical factors.

Our findings support the growing body of literature that emphasizes the importance of structured oncology nursing interventions in managing chemotherapy-induced toxicities. As highlighted in recent studies, proactive toxicity management is becoming increasingly essential in modern cancer care.[9] Telehealth and symptom monitoring interventions have been shown to improve patient outcomes by enabling early identification and management of adverse effects. Our study adds to this body of work by demonstrating the benefits of structured, nurse-led interventions in the outpatient setting, where resource constraints often limit the ability to provide intensive, in-person care. Moreover, the integration of digital health tools in oncology nursing interventions offers a promising strategy for enhancing the scalability of supportive care programs. In resource-limited settings, telehealth and structured nursing interventions could reduce the burden on healthcare systems while improving patient outcomes. Future research should explore the long-term effects of such interventions on both clinical outcomes, such as survival rates and progression-free survival, and psychosocial factors, including quality of life and patient confidence in managing their treatment. In addition to reducing chemotherapy-related toxicities and hospital visits, our structured oncology nursing intervention also has potential benefits for improving Health-Related Quality of Life (HRQOL). Proactive symptom management, including early detection and individualized care plans, can help alleviate the physical and psychological burden of chemotherapy. Improved symptom control, along with enhanced patient education and support, likely contributes to better HRQOL by reducing distress and promoting treatment adherence. Future studies should explore HRQOL more comprehensively to better capture the broader benefits of structured nursing interventions in cancer care.

In addition to its clinical and psychosocial advantages, our findings also reflect the potential for digital health integration in modern oncology nursing. The use of standardized checklists, electronic documentation of toxicity symptoms, and escalation protocols enabled real-time data sharing and timely decision-making. These digital tools empower nursing teams to deliver individualized and responsive care. Prior studies, such as those by Lee et al and Kwok et al, have similarly emphasized the importance of nurse-led telehealth and symptom management systems in cancer care, particularly in outpatient and home-based settings.[19,20] Our study extends this evidence by showing that such approaches are not only effective but scalable for routine integration within chemotherapy programs. Furthermore, this intervention model holds special value in healthcare environments with limited oncologist availability or resource constraints. By equipping oncology nurses with structured protocols and decision-making tools, hospitals can decentralize part of the clinical workload while maintaining high-quality care standards. In rural or underserved areas, nurse-led toxicity monitoring may be especially impactful, bridging access gaps and enhancing patient safety without the need for frequent in-person clinic visits. While reduced hospital visits and treatment delays suggest potential cost savings, this retrospective study did not quantify economic outcomes. Future research should incorporate formal cost-effectiveness analyses to inform implementation decisions at the health system level. And the findings suggest that oncology nursing interventions could improve patient outcomes by addressing chemotherapy toxicities, there are practical barriers to implementing such programs in clinical practice. These include the need for specialized training for nursing staff, adequate staffing levels, and institutional support. Furthermore, future research should explore hybrid digital-health models that could help reduce nursing workload while maintaining high-quality care. Such models could facilitate more widespread adoption of this intervention in busy clinical settings.

Despite the promising results, this study has several limitations. First, as a retrospective, single-center study, the generalizability of our findings may be limited. Although propensity score matching was used to control for baseline differences, residual confounding may still exist. Second, some toxicity data were based on patient self-report during follow-up calls, which could introduce recall bias. Third, the study did not assess long-term oncologic outcomes, such as progression-free or overall survival, which may be affected by treatment adherence and toxicity burden. Additionally, a formal cost-effectiveness analysis was not conducted, though reduced hospital visits and shorter admissions suggest potential savings. The single-center design, conducted at a tertiary cancer hospital in China, may limit the applicability of the results to other healthcare systems. Future multicenter studies are needed to validate the broader applicability of the intervention. Furthermore, the lack of long-term follow-up data on survival and quality of life beyond initial chemotherapy cycles is another limitation. Future studies with extended follow-up are needed to evaluate the long-term impacts of structured oncology nursing interventions. Lastly, while the study demonstrated the benefits of structured oncology nursing interventions, baseline differences between groups could have influenced the results. These factors should be addressed in future research to improve the clarity of findings. Future research should include multicenter prospective trials to validate the effectiveness of structured nursing interventions across diverse populations and clinical settings. It will also be valuable to explore hybrid models that incorporate artificial intelligence–assisted symptom alerts, mobile health platforms, and wearable monitoring to further enhance nursing responsiveness and decision support. Moreover, qualitative studies examining the patient experience of nurse-led care can yield insights into the interpersonal dimensions of oncology nursing, which are often under-recognized yet vital to therapeutic success.

Conclusion

In conclusion, the findings from this study demonstrate that structured oncology nursing interventions significantly improve the management of chemotherapy-induced toxicities, reduce hospital visits, and enhance treatment adherence. These interventions not only contribute to better clinical outcomes but also improve patient well-being, suggesting a positive impact on Health-Related Quality of Life. The integration of such models into routine oncology care could provide significant benefits, particularly in outpatient settings.

Data Sharing Statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval and Consent to Participation

Written informed consent was obtained from all participants. This research was performed in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of Hubei Cancer Hospital, Tongji Medical College, Huazhong University of Science and Technology.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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