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Determinants of Treatment Delay and Its Impact on Clinical Outcomes Among Cancer Patients

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ABSTRACT

Background: Timely initiation of cancer treatment is essential for disease control and optimal clinical outcomes. In resource-constrained settings, delays may arise from socioeconomic disadvantage, geographical barriers, fragmented referral pathways, and repeated healthcare visits. **Aim of the study:** To determine the major factors associated with treatment delay and evaluate its association with adverse clinical outcomes among cancer patients. **Methods & Materials:** This hospital-based observational study included 250 adult patients with confirmed malignancy who were newly diagnosed or awaiting initiation of definitive cancer-directed treatment. Sociodemographic, clinical, healthcare-seeking, diagnostic, and treatment-related information was collected through structured interviews and medical-record review. Treatment delay was defined as >30 days from symptom onset to initiation of definitive treatment. Associations were assessed using chi-square/Fisher's exact tests, followed by multivariable logistic regression to identify independent determinants of treatment delay and adverse clinical outcomes. **Results:** The mean age was 52.8±13.7 years, and 63.2% of patients were from rural areas. Overall treatment delay >30 days occurred in 58.8%, with a mean symptom-onset-to-treatment interval of 120.1±54.8 days. Rural residence, lower educational attainment, household income <20,000 BDT, distance >100 km, initial consultation outside a specialist centre, and ≥3 healthcare visits before diagnosis were independently associated with treatment delay. Patients with delayed treatment had significantly higher proportions of advanced disease, progressive metastasis, poor ECOG performance status, emergency admission, treatment interruption, and incomplete planned treatment. Treatment delay >30 days remained independently associated with adverse clinical outcomes (aOR 2.67, 95% CI 1.55–4.61; p<0.001), alongside stage III/IV disease, ECOG ≥2, and metastatic disease. **Conclusion:** Treatment delay was common and was strongly associated with socioeconomic, geographical, and healthcare-pathway barriers. Delayed treatment was independently associated with adverse clinical outcomes, emphasizing the need for earlier referral, coordinated diagnostic pathways, and equitable access to timely cancer treatment.

Keywords: *Cancer; Treatment delay; Healthcare access; Socioeconomic determinants; Clinical outcomes.*

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INTRODUCTION

Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells, which can invade surrounding tissues and metastasize to distant organs. Its prognosis depends not only on tumor biology and stage but also on how rapidly patients move through the cancer-care pathway, from recognition of symptoms and diagnosis to initiation and completion of appropriate treatment. It will generate locally relevant evidence to support more timely and equitable cancer care in Bangladesh [1,2]. Worldwide, cancer accounted for approximately 19.98 million new cases and 53.50 million five-year prevalent cases [3]. In Bangladesh, cancer was estimated at 346,337 five-year prevalent cases, reflecting a substantial burden of cancer in the country [4]. Treatment delay refers to an unnecessarily prolonged interval between cancer diagnosis and initiation of definitive therapy or between sequential treatment modalities [5]. The cancer-care process generally involves symptom recognition, healthcare seeking, diagnostic evaluation, pathological confirmation, staging, treatment planning, and commencement of surgery, chemotherapy, radiotherapy, targeted therapy, or combinations of these approaches. Delays can occur at any of these stages and may arise from patient-related, socioeconomic, healthcare-provider, or health-system factors [6,7]. The determinants of treatment delay are therefore multidimensional. Limited cancer awareness, fear of diagnosis or treatment, reliance on traditional or alternative therapies, financial difficulties, transportation problems, geographical barriers, inadequate social support, and low educational attainment may postpone healthcare utilization [6,8]. In low- and middle-income countries (LMICs), these challenges are further compounded by shortages of trained personnel, inadequate infrastructure, fragmented referral systems, and limited availability or affordability of anticancer medicines [9,10]. The consequences of delayed treatment can be clinically serious. Prolonged waiting may permit tumor progression, increase the likelihood of advanced-stage disease, reduce opportunities for curative treatment, and adversely affect quality of life and survival. Each four-week increase in treatment delay was associated with increased mortality across several cancer types and treatment modalities [5]. Longer diagnostic or treatment intervals can adversely influence stage and survival, although the magnitude of effect differs according to cancer type and treatment pathway [11,12]. Despite this evidence, important limitations remain. Studies have frequently focused on a single cancer type or a specific component of delay, while patient, socioeconomic, clinical, and health-system determinants have not always been evaluated together. Moreover, substantial methodological variation exists in defining and measuring treatment delay, making comparisons between studies difficult [11,12]. Evidence specifically integrating

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determinants of treatment delay with subsequent clinical outcomes among Bangladeshi cancer patients remains comparatively limited. This gap is important because identifying modifiable causes of delay can help clinicians and health authorities prioritize interventions such as earlier referral, patient navigation, financial support, improved diagnostic coordination, and more efficient treatment scheduling [10,13]. Therefore, the present study aimed to determine the major factors associated with treatment delay and to assess its impact on clinical outcomes among cancer patients.

METHODS & MATERIALS

This hospital-based observational study was conducted in the Department of Clinical Oncology, Bangladesh Medical University, Dhaka, Bangladesh, from January 2024 to December 2025. A total of 250 eligible adult cancer patients were enrolled consecutively according to predefined inclusion and exclusion criteria.

Inclusion Criteria

- Patients aged ≥18 years with a confirmed diagnosis of malignancy.
- Patients who were newly diagnosed or were presenting for initiation of definitive cancer-directed treatment.
- Patients with adequate sociodemographic, clinical, diagnostic, and treatment-related information.

Exclusion Criteria

- Patients who had already completed definitive treatment before presentation.
- Patients with substantially incomplete medical records or unavailable information regarding major treatment-related time points.
- Patients unwilling to provide informed consent.

Ethical Considerations

The study protocol was reviewed and approved by the appropriate institutional ethics committee before commencement. Written informed consent was obtained from all participants. Participation was voluntary, and participants were informed of their right to withdraw at any stage without affecting their medical care. Personal identifiers were excluded from the analytical dataset, and confidentiality of all collected information was maintained throughout the study.

Data Collection

Data were collected using a structured interviewer-administered questionnaire supplemented by review of hospital records, pathology reports, imaging findings, treatment records, and clinical notes. Sociodemographic variables included age, sex, residence, educational level, monthly household income, and distance from the treatment centre. Clinical and disease-related variables included cancer type, stage at treatment initiation, comorbidity, Eastern Cooperative Oncology Group (ECOG) performance status, metastatic disease, and initial treatment modality. Information regarding the healthcare-seeking pathway included the initial healthcare provider, number of healthcare visits before diagnosis, and relevant dates of symptom onset, first consultation, definitive diagnosis, and treatment initiation. Whenever possible, reported dates were cross-checked against available clinical records to minimize recall error.

Assessment of Treatment Delay and Clinical Outcomes

Treatment delay was defined as the interval between symptom onset and initiation of definitive cancer-directed treatment. Overall treatment delay was categorized as ≤30 days or >30 days. Patient-related delay was defined as the interval from symptom onset to first medical consultation and categorized as ≤14 or >14 days. Diagnostic delay represented the interval from first consultation to definitive diagnosis and was categorized as ≤30 or >30 days. Health-system delay represented the interval attributable to healthcare access or treatment organization and was categorized as ≤14 or >14 days. The diagnosis-to-treatment interval was further categorized as ≤30, 31–60, 61–90, and >90 days.

Clinical outcomes included advanced disease stage (III/IV), new or progressive metastasis, poor performance status (ECOG ≥2), emergency hospital admission, treatment interruption, incomplete planned treatment, and 30-day mortality. A composite adverse clinical outcome was defined as the occurrence of at least one of these adverse outcomes.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 26.0. Continuous variables were expressed as mean±standard deviation, while categorical variables were presented as frequencies and percentages. Associations between treatment-delay status and categorical clinical or sociodemographic variables were assessed using the chi-square test or Fisher's exact test, as appropriate. Binary logistic regression was performed to identify independent determinants of treatment delay >30 days, with results presented as adjusted odds ratios with 95% CIs. All tests were two-sided, and a p-value <0.05 was considered statistically significant.

RESULTS

The mean age was 52.8±13.7 years. The largest age group was 50–59 years (28.8%), followed by 60–69 years (24.4%) and 40–49 years (22.8%). Males comprised 55.6% and females 44.4%. Most patients were from rural areas (63.2%). Regarding education, 28.4% had primary education, 26.0% secondary education, 24.8% no formal education, and 20.8% higher secondary or above. Monthly household income was <20,000 BDT in 38.4%, and a total of 41.6% lived ≤50 km from the treatment centre, while 26.8% lived >100 km (*Table I*).

Table I
Sociodemographic characteristics of cancer patients (*n*=250).

Variables	Frequency (n)	Percentage (%)
Age group (years)		
<40	31	12.4
40–49	57	22.8
50–59	72	28.8
60–69	61	24.4
≥70	29	11.6
Mean ± SD	52.8 ± 13.7	
Gender		
Male	139	55.6
Female	111	44.4
Residence		
Urban	92	36.8
Rural	158	63.2
Education		
No formal education	62	24.8
Primary	71	28.4
Secondary	65	26.0
Higher secondary or above	52	20.8
Monthly household income		
<20,000 BDT	96	38.4
20,000–39,999 BDT	88	35.2
≥40,000 BDT	66	26.4
Distance from treatment centre		
≤50 km	104	41.6
51–100 km	79	31.6
>100 km	67	26.8

Breast cancer was the predominant malignancy (24.4%), followed by gastrointestinal cancer (21.2%) and lung cancer (16.8%). At treatment initiation, 39.2% had stage III disease and 26.8% had stage IV, whereas 9.6% had stage I. Comorbidity was present in 43.2% patients. ECOG performance status was 0–1 in 60.4%, 2 in 26.4%, and ≥3 in 13.2%. Metastatic disease was present in 37.2%. Chemotherapy was the most common initial treatment modality (36.4%), followed by surgery (28.8%), radiotherapy (21.6%), and combined treatment (13.2%) (*Table II*).

Table II
Clinical and disease-related characteristics (*n*=250).

Variables	Frequency (n)	Percentage (%)
Cancer type		
Breast cancer	61	24.4
Lung cancer	42	16.8
Gastrointestinal cancer	53	21.2
Cervical cancer	31	12.4
Head and neck cancer	28	11.2
Hematological malignancy	20	8.0
Other solid malignancies	15	6.0
Stage at treatment initiation		
Stage I	24	9.6
Stage II	61	24.4
Stage III	98	39.2
Stage IV	67	26.8
Comorbidity		
None	142	56.8
≥1 comorbidity	108	43.2
ECOG performance status		
0–1	151	60.4
2	66	26.4
≥3	33	13.2
Metastatic disease		
No	157	62.8
Yes	93	37.2
Initial treatment modality		
Surgery	72	28.8
Chemotherapy	91	36.4
Radiotherapy	54	21.6
Combined/multimodal	33	13.2

Overall treatment delay >30 days occurred in 58.8%, compared with 41.2% who initiated treatment within 30 days. Patient-related delay >14 days was observed in 53.6%, diagnostic delay >30 days in 48.4%, and health-system delay >14 days in 45.2%. The diagnosis-to-treatment interval was ≤30 days in 41.2%, 31–60 days in 31.2%, 61–90 days in 17.2%, and >90 days in 10.4% (*Table III*).

Table III
Treatment-delay characteristics (*n*=250).

Variables	Frequency (n)	Percentage (%)
Overall treatment delay		
≤30 days	103	41.2
>30 days	147	58.8
Patient-related delay		
≤14 days	116	46.4
>14 days	134	53.6
Diagnostic delay		
≤30 days	129	51.6
>30 days	121	48.4
Health-system delay		
≤14 days	137	54.8
>14 days	113	45.2
Diagnosis-to-treatment interval		
≤30 days	103	41.2
31–60 days	78	31.2
61–90 days	43	17.2
>90 days	26	10.4
Continuous delay variables		
Symptom onset → first consultation	47.6 ± 31.4 days	
First consultation → definitive diagnosis	32.8 ± 24.7 days	
Definitive diagnosis → treatment initiation	39.7 ± 28.6 days	
Overall symptom onset → treatment initiation	120.1 ± 54.8 days	

Treatment delay was significantly associated with rural residence (p=0.003), lower educational attainment (p=0.013), household income <20,000 BDT (p=0.003), distance >100 km from the treatment centre (p=0.006), and initial consultation outside a specialist/tertiary centre (p=0.005). Age (p=0.328) and gender (p=0.241) were not significantly associated with delay (*Table IV*).

Table IV
Factors associated with treatment delay >30 days.

Variables	Delayed >30 days		Not delayed ≤30 days		p-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Age					
≥60 years	56	62.2	34	37.8	0.328
<60 years	91	56.9	69	43.1	
Gender					
Male	77	55.4	62	44.6	0.241
Female	70	63.1	41	36.9	
Residence					
Urban	43	46.7	49	53.3	0.003
Rural	104	65.8	54	34.2	
Education					
Secondary or above	59	50.4	58	49.6	0.013
No formal/primary	88	66.2	45	33.8	
Income					
≥20,000 BDT	79	51.3	75	48.7	0.003
<20,000 BDT	68	70.8	28	29.2	
Distance					
≤100 km	98	53.6	85	46.4	0.006
>100 km	49	73.1	18	26.9	
Initial provider					
Specialist/tertiary centre	56	49.1	58	50.9	0.005
Non-specialist/private	91	66.9	45	33.1	

Patients with treatment delay >30 days had significantly higher proportions of stage III/IV disease (p=0.033), new or progressive metastasis (p=0.001), poor performance status (p=0.006), emergency admission (p=0.013), treatment interruption (p=0.022), and incomplete planned treatment (p=0.026). Thirty-day mortality was higher among delayed patients (14.3% and 6.8%), although this difference was not statistically significant (p=0.061) (*Table V*).

Table V
Clinical outcomes according to treatment-delay status (*n*=250).

Variables	Delayed >30 days		Not delayed ≤30 days		p-value
	Frequency (n)	Percentage (%)	Frequency (n)	Percentage (%)	
Advanced disease stage (III/IV)					
Yes	105	71.4	60	58.3	0.033
No	42	28.6	43	41.7	
New/progressive metastasis					
Yes	67	45.6	26	25.2	0.001
No	80	54.4	77	74.8	
Poor performance status (ECOG ≥2)					
Yes	62	42.2	26	25.2	0.006
No	85	57.8	77	74.8	
Emergency hospital admission					
Yes	48	32.7	19	18.4	0.013
No	99	67.3	84	81.6	
Treatment interruption					
Yes	43	29.3	17	16.5	0.022
No	104	70.7	86	83.5	
Incomplete planned treatment					
Yes	39	26.5	15	14.6	0.026
No	108	73.5	88	85.4	
30-day mortality					
Yes	21	14.3	7	6.8	0.061
No	126	85.7	96	93.2	

After adjustment, independent predictors of treatment delay >30 days included rural residence (aOR 1.82, p=0.036), no formal/primary education (p=0.042), income <20,000 BDT (p=0.013), distance >100 km (p=0.011), initial consultation outside a specialist centre (p=0.018), and ≥3 healthcare visits before diagnosis (p=0.003). Age, female gender, and comorbidity were not significant independent predictors (*Table VI*).

Table VI
Multivariable logistic regression for determinants of treatment delay >30 days.

Variables	aOR	95% CI	p-value
Age ≥60 years	1.21	0.70–2.09	0.492
Rural residence	1.82	1.04–3.18	0.036
No formal/primary education	1.76	1.02–3.05	0.042
Monthly income <20,000 BDT	2.03	1.16–3.55	0.013
Distance >100 km	2.24	1.20–4.18	0.011
Initial consultation outside specialist centre	1.91	1.12–3.27	0.018
≥3 healthcare visits before diagnosis	2.38	1.35–4.19	0.003
Female gender	1.18	0.69–2.02	0.552
Comorbidity ≥1	1.29	0.76–2.19	0.343

Treatment delay >30 days was independently associated with adverse clinical outcomes (aOR 2.67). Other significant predictors were stage III/IV disease at treatment initiation (3.84), ECOG ≥2 (2.91), and metastatic disease (3.27); all had p<0.001 (*Table VII*).

Table VII
Multivariable logistic regression for adverse clinical outcome.

Variables	aOR	95% CI	p-value
Treatment delay >30 days	2.67	1.55–4.61	<0.001
Stage III/IV at treatment initiation	3.84	2.17–6.81	<0.001
ECOG performance status ≥2	2.91	1.64–5.17	<0.001
Metastatic disease	3.27	1.86–5.76	<0.001

The largest proportion of patients had a diagnosis-to-treatment interval of ≤30 days (41.2%), while 31.2%, 17.2%, and 10.4% had intervals of 31–60, 61–90, and >90 days, respectively (*Figure 1*).

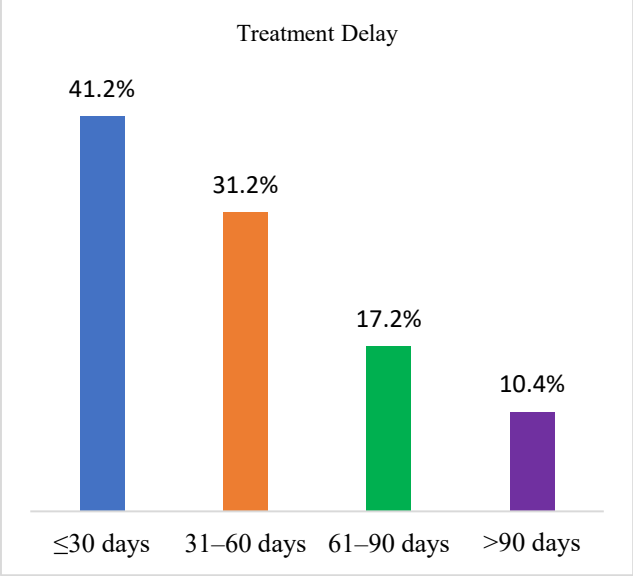


Figure 1 Distribution of cancer patients according to diagnosis-to-treatment interval (*n*=250).

51.2% had ≥1 adverse clinical outcome and 48.8% had no adverse clinical outcome (*Figure 2*).

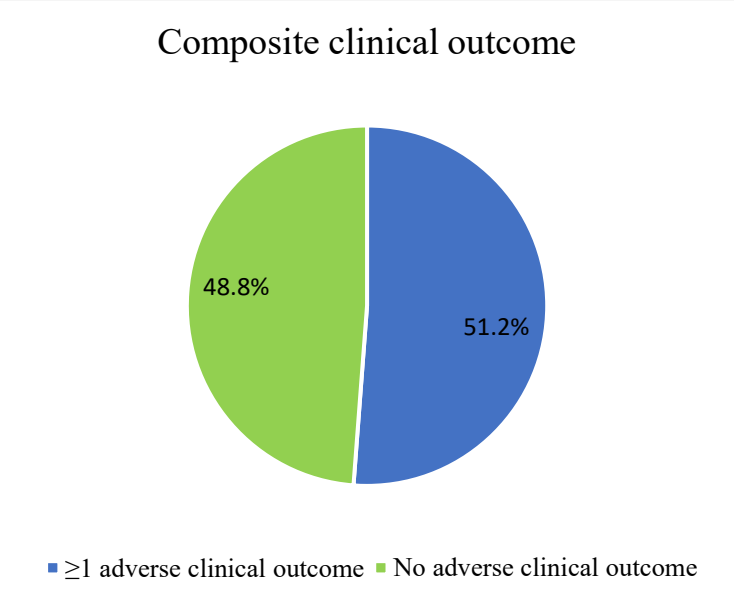


Figure 2 Distribution of cancer patients according to the occurrence of adverse clinical outcomes (*n*=250).

DISCUSSION

Treatment delay demonstrates as a clinically important and potentially modifiable barrier to effective cancer care, as prolonged delays may contribute to disease progression, compromised treatment outcomes, and increased mortality risk [5]. In present study, the mean age was 52.8±13.7 years, 63.2% residing in rural areas, and 53.2% having no formal or only primary education. These findings are consistent with Ansar et al., who reported that rural residence, lower education, and lower income were associated with less appropriate initial healthcare-seeking among patients with lung cancer [14]. Similarly, Majeed et al. found significantly greater cancer-care delay among rural and lower-income patients in Pakistan [15]. In contrast, a large study by Nguyen et al. found that rural breast cancer patients were more likely to have lower income and educational attainment, although they experienced shorter treatment-initiation intervals when treated at accredited cancer centres [16]. Our study had a substantial burden of advanced disease, with 39.2% presenting at stage III and 26.8% at stage IV, while 37.2% had metastatic disease. This pattern is comparable with Lokanatha et al., who reported stage III/IV disease in 91.5% of oesophageal and 90% of gastric cancer patients in a developing-country tertiary-care setting, with delayed treatment strongly influenced by socioeconomic status, education, and non-specialist evaluation [17]. Similarly, Sun et al. demonstrated substantial international variation in cancer stage at presentation, particularly across health systems with limited diagnostic capacity [18]. Treatment delay was prominent in the present study, with 58.8% experiencing >30 days of delay and a mean overall symptom-onset-to-treatment interval of 120.1±54.8 days. The individual intervals-47.6±31.4 days from symptom onset to first consultation, 32.8±24.7 days from consultation to diagnosis, and 39.7±28.6 days from diagnosis to treatment. This is closely comparable with Ansar et al., who reported a 151-day median symptom-to-treatment interval among Bangladeshi lung cancer patients, including 121 days to diagnostic confirmation [14]. Hanna et al.

found that treatment pathways were substantially longer in lower-income settings, particularly during the patient interval [5]. More recently, Petrova et al. also showed that patient intervals in lower-income countries were generally 1.5–4 times longer than those in high-income countries [19]. Treatment delay was significantly associated with rural residence, lower education, lower income, greater travel distance, and initial consultation outside specialist centres. These findings closely resemble those of Majeed et al., who observed significant associations between rural residence, low household income, and delayed breast cancer care in Pakistan [15]. Similarly, Makene et al. demonstrated that lower education and income were associated with prolonged cancer-care pathways in Tanzania, with repeated movement between healthcare providers contributing to additional delays [20]. In contrast, Togawa et al. found that rural residence was associated with diagnostic delay before adjustment but that the association weakened after accounting for socioeconomic characteristics [21]. Patients with >30-day treatment delay experienced significantly more stage III/IV disease (71.4%), new or progressive metastasis (45.6%), poor ECOG status (42.2%), emergency admission (32.7%), treatment interruption (29.3%), and incomplete planned treatment (26.5%). These findings are consistent with Shih et al., who demonstrated that prolonged diagnosis-to-treatment intervals were associated with substantially higher mortality among selected stage II and stage IV breast cancer subgroups [22]. Likewise, Morris et al. reported that rural patients experiencing treatment delay had markedly poorer survival and greater treatment nonadherence than patients without delay [23]. After adjustment, ≥3 healthcare visits before diagnosis were the strongest independent determinant of treatment delay (aOR 2.38), followed by distance >100 km (2.24), income <20,000 BDT (2.03), consultation outside a specialist centre (1.91), rural residence (1.82), and limited education (1.76). These findings are supported by Ansar et al., who found that Bangladeshi patients initially consulting informal providers had substantially longer diagnostic pathways [14]. The association between low socioeconomic status and delay is also consistent with Makene et al., who demonstrated that financially disadvantaged patients experienced slower and more costly pathways to cancer diagnosis [20]. Conversely, comorbidity was not independently associated with delay in our study, unlike Sheni et al., who identified comorbidity as a predictor of delayed treatment for selected cancer types [24]. Treatment delay >30 days remained independently associated with adverse clinical outcomes (aOR 2.67, 95% CI 1.55–4.61; p<0.001) after adjustment for stage, ECOG status, and metastatic disease. Similar results come from Shih et al., who found stage-dependent mortality effects of prolonged treatment intervals in breast cancer, and from Morris et al., who demonstrated particularly poor survival among rural patients experiencing treatment delay [22,23].

LIMITATIONS

The use of symptom onset as the starting point for overall delay may have introduced recall error despite cross-checking available records. The composite adverse-outcome definition combined clinically heterogeneous events, potentially obscuring outcome-specific effects. Furthermore, heterogeneity in cancer type, stage, and treatment modality may have influenced delay–outcome associations, while unmeasured factors such as treatment capacity and institutional waiting times could not be fully accounted for.

CONCLUSION & RECOMMENDATIONS

Treatment delay was common among cancer patients and was independently associated with rural residence, socioeconomic disadvantage, geographical distance, non-specialist initial consultation, and repeated healthcare visits. Importantly, delay >30 days was independently associated with adverse clinical outcomes after adjustment for disease severity and performance status. Cancer-care programs should therefore prioritize early specialist referral, coordinated diagnostic services, patient-navigation mechanisms, and targeted financial and transportation support for disadvantaged patients. Strengthening referral networks between primary, secondary, and tertiary facilities may reduce avoidable delays and facilitate earlier initiation of definitive treatment.

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CONFLICT OF INTEREST

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