DOI: https://doi.org/10.54393/pjhs.v7i6.3904

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 7, Issue 06 (June 2026)

Original Article

OPEN ACCESS

Clinical Features and Prognosis of Cancer Patients Requiring Intensive Care Unit Admission

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ARTICLE INFO

Keywords:
Cancer, Critical Illness, Intensive Care Units, Prognosis, Treatment Outcome

How to Cite:
Sunil, R. K., Alvi, A., Baloch, S. A., & Khan, T. (2026). Clinical Features and Prognosis of Cancer Patients Requiring Intensive Care Unit Admission: Clinical Features and Prognosis in ICU Cancer Patients. Pakistan Journal of Health Sciences, 7(6), 133-139. https://doi.org/10.54393/pjhs.v7i6.3904

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Received Date: 28th January, 2026
1st Revision Received: 2nd April, 2026
2nd Revision Received: 20th April, 2026
3rd Revision Received: 6th May, 2026
Acceptance Date: 12th May, 2026
Published Date: 30th June, 2026

ABSTRACT

Cancer patients are at risk of admission to the critical care unit either due to primary illness or as a consequence of treatment. **Objectives:** To determine clinical features and cancer patients' prognosis necessitating ICU (Intensive Care Unit) admission. **Methods:** This cross-sectional analytical study at the critical care unit of Ziauddin Medical University Hospital was done on cancer patients fulfilling eligibility criteria between July 2023 and December 2023. Along with demographics, Acute Physiology and Chronic Health Evaluation (APACHE) II score, Sequential Organ Failure Assessment (SOFA) score, and ECOG were reported. SPSS version 23.0 was used for data analysis. For comparing clinical characteristics and outcomes between different subgroups, the t-test and chi-square test were applied, keeping $p<0.05$ as statistically significant. **Results:** Patients having hematological malignancy had a significantly lengthier hospital stay before ICU admittance compared to those with solid tumors ($p=0.01$). Chemotherapy use was significantly more frequent ($p<0.01$), and sepsis/septic shock was a more common cause of ICU admission ($p=0.05$). On ICU admission, renal dysfunction ($p<0.01$), leukocyte count ($p=0.04$), thrombocyte count ($p=0.05$), and C-reactive protein levels ($p<0.01$) showed significant differences between the groups. During ICU stay, sepsis/septic shock remained significantly different between groups ($p<0.01$). Additionally, overall survival outcomes differed significantly, with higher survival observed in patients with solid tumors ($p<0.01$). **Conclusion:** The type of malignancy significantly influenced ICU outcomes, with hematological cancers associated with greater disease severity and poorer prognosis, while solid tumors showed better survival.

INTRODUCTION

Since cancer leads to a substantial effect on an individual's health, a profound understanding of its clinical manifestations and prognosis is a necessity [1]. Worldwide, estimates show around 20 million new cases in the last decade, with around 10 million deaths due to cancer. The increasing burden of cancer is predicted to reach approximately 60 % in the next 20 years, which will lead to further adverse effects on the health care system [2]. Diagnosis and treatment of cancers in their early phases are critical for patient survival throughout the globe [3]. Many cancer patients require admission to the highest medical interventional levels, i.e., necessitating ICU admittance [4]. The purpose of admitting cancer patients to the ICU is probably due to a life-threatening situation/s or an increase in the complexity of such patients [5]. Such critical care scenarios require an in-depth comprehension of the clinical features demonstrated by cancer patients and carefully need to be evaluated for prognostic features that influence outcomes [6]. Research has demonstrated varied clinical presentations in cancer patients that were admitted to the ICU, including evaluation of stage, type of cancer, and complications associated with treatment [7].

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Concurrently, it remains vital to evaluate prognostic determinants that will shape the future of such cases, including cancer's characteristics, dysfunctional organs, severity of the cancer, status of immunity, and influences of age and co-morbidities [8]. Through assessment of clinical characteristics and prognostic factors among cancer patients requiring ICU, it will aid in refining current guidelines, helping to provide enhanced healthcare and improve overall outcomes. Complications in cancer patients occur either in non-septic or in septic type overall, the duration of their cancer, and during therapies [9]. A timely, accurate, and proper evaluation can be made by proper evaluation. There is always a possibility of recovery from such complications if managed in a timely and careful manner. But if we labeled these cancer patients as they have deadly disease and marked them as not aggressive just because the malignancy has no outcome (as previously thought), then it ultimately affects the survival of these patients. It is vital to evaluate which cancer patients need ICU care the most, how they respond, and what their outcome is [10, 11]. Cancer patients account for up to 15% of all ICU admissions [12]. However, admitting cancer patients to the ICU may be fraught with controversy. Despite the fact that advances in oncology and supportive care appear to be associated with improved patient survival rates, many intensivists are still hesitant to admit these patients to the ICU [13, 14].

Limited local data exists on the clinical profile and outcomes of cancer patients admitted to the ICU, particularly in low- and middle-income settings like Pakistan, where findings from high-income countries may not be generalizable. Cancer patients requiring ICU care have high morbidity and mortality, yet the lack of local evidence limits effective risk stratification and clinical decision-making. The study aimed to assess and identify the clinical features, outcome, and prognosis of cancer patients requiring ICU admission.

METHODS

This research used an analytical cross-sectional study design that was carried out at the critical care unit of Ziauddin Medical University Hospital, Karachi, Pakistan [reference number: 7390623RKONC; dated 12th July 2023]. The study duration was for 6 months after approval of the research proposal. Using non-probability convenient sampling, all cancer patients fulfilling the inclusion criteria between July 2023 and December 2023, including patients of either gender and above 18 years of age with diagnosed cases of malignancy, were included in the study, whereas patients who were admitted on more than one occasion to the ICU during the same stay in hospital, only their first data point was included in the study. Moreover, patients who died within 24 hours of admission to the ICU, as well as patients having a length of hospitalization stay in the ICU <24 hours, were excluded from the study. To minimize survivorship bias, ICU stays of patients <24 hours were excluded, since such cases seldom represent either extreme in terms of early death and transient admission to ICU without adequate clinical evaluation. The required sample size was estimated using a two-group comparison of proportions (solid vs. hematological malignancies), assuming a difference in mortality of 25% between groups, a confidence level of 95%, and a power of 80%. A total of 80 samples were calculated using the formula. After approval of the research proposal, data were collected from electronic medical records of the critical care unit of the hospital during the study period. The demographics included age, gender, duration of hospital stay, duration of ICU stay, characteristics of cancer on ICU admission, type of cancer, its stage, primary site of cancer, status of metastasis, treatment status, cause of ICU admission, any bacterial, fungal, pulmonary or blood stream infection, mortality and co-morbidities both on pre-hospital admission and on ICU admission and Glasgow Coma Scale (GCS). APACHE II, SOFA, and ECOG scores for pre-admission performance status were reported. In addition, laboratory data included complete blood counts, C-reactive protein, liver function tests (ALT, LDH), procalcitonin, calcium, albumin, glucose, and creatinine. ICU-associated morbidities included septic shock or sepsis, renal or hepatic dysfunction, renal replacement therapy, neutropenia, mechanical ventilation, blood transfusion, chemotherapy, culture-proven or suspected infection, catheterization, use of vaspressors or steroids, and all were recorded.

For data analysis, SPSS version 23.0 was used. The data included demographical characteristics, cancer-associated factors, and clinical data, which were presented as frequencies and percentages for qualitative variables, while means and standard deviations were used for quantitative variables. To compare clinical characteristics and outcomes on the basis of cancer subtypes, independent t-tests and chi-square tests were applied. A p-value of <0.05 was considered statistically significant.

RESULTS

There was a total of 510 admissions that took place during the study, amongst which 81 (15.88 %) were patients with cancer who met the inclusion criterion for this study. Median age was 58 (43-69) years, with the majority being females (59.26 %). The most common cause of patient admission into the ICU was due to septic shock/sepsis in about 64.2% of patients, followed by respiratory failure in 58 % of patients. Median length of hospital stay before ICU admission was 3.8 (1-19) days, and median length of ICU stay was 6.2 (4-14) days. In terms of the characteristics of cancer on admission into ICU, 34.57 % of patients were

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newly diagnosed, 32.1 % with relapse of progressive disease, 23.46 % with complete or partial remission, while 9.88 % with end-stage disease. 71.6 % of patients reported a good ECOG score on pre-admission performance status. 70.37 % of patients underwent chemotherapy, while 51.9 % patients had cancer therapy within 30 days before ICU admission. Radiation therapy was carried out in 24.7 % of patients, while surgery was carried out in 27.2 % of patients. 26 % of patients in this study were diabetic, followed by hypertension in 24.7 %, cardiovascular disease in 14.8 %, and COPD in 11.11 % of patients. The most common morbidity in patients on ICU admission was either suspected or culture-proven infection, in about 84 % of patients, followed by thrombocytopenia in 50.62 %, and renal dysfunction in 48.14 % patients. The most common type of infection was pulmonary, in 70.37 % of patients (Table 1).

Table 1: Demographical characteristics of included patients (n=81)

Variables		Frequency (%) / Median ± IQR
Age (years)		58 (43-69)
Gender	Male	33 (40.74 %)
	Female	48 (59.26 %)
Hospital stay before admission to ICU (days)		3.8 (1-19)
Length of ICU stay (days)		6.2 (4-14)
Stage of Cancer	Recently diagnosed	28 (34.57 %)
	Complete or partial remission	19 (23.46 %)
	Relapse or progressive disease	26 (32.1 %)
	End stage	08 (9.88 %)
Performance Status	Good (ECOG 0-2)	58 (71.6 %)
	Poor (ECOG 3 and 4)	23 (28.4 %)
Treatment	Chemo	57 (70.37 %)
	Radiation	20 (24.7 %)
	Surgery	22 (27.2 %)
	Therapy < 30 days before ICU admit	42 (51.9 %)
Comorbidities	COPD	09 (11.11 %)
	Diabetes mellitus	21 (26 %)
	Hypertension	20 (24.7 %)
	Cardiovascular diseases	12 (14.8 %)
Reason for ICU Admission	Sepsis/septic shock	52 (64.2 %)
	Respiratory failure	47 (58 %)
	Acute renal failure	27 (33.33 %)
ICU-Associated Comorbidities	Renal Dysfunction	39 (48.14 %)
	Neutropenia	24 (29.63 %)
	Thrombocytopenia	41 (50.62 %)
	Mechanical ventilation	36 (44.44 %)
	Hepatic Dysfunction	27 (33.33 %)
	Vasopressors	28 (34.57 %)
	>2 organ dysfunction	39 (48.14 %)
	Infection	68 (84 %)
Bacterial Infection		36 (44.44 %)
Fungal Infection		11 (13.58 %)
Pulmonary Infection		57 (70.37 %)
Bloodstream Infection		16 (19.75 %)

A total of 50 patients were reported to have solid tumors, amongst which the most common type of cancer was Non-Hodgkin Lymphoma (Figure 1).

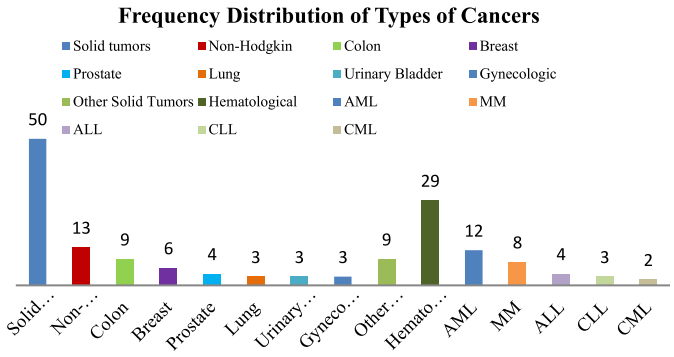

Figure 1: Frequency distribution of Cancer Types in the Study Population

The clinical features of the included patients when admitted to the ICU (Table 2).

Table 2: Clinical Features of Included Patients (n=81)

Clinical Features on ICU Admission	Median ± IQR
APACHE II score	22 (16-27)
GCS	13 (9-15)
SOFA score	9 (4-11)
Hemoglobin level (g/dL)	9.7 (7.9-10.2)
Leukocytes (/mm3)	7,980 (3375-14450)
Thrombocytes (/mm3)	112,000 (42000-228000)
C-reactive protein (mg/L)	144 (72.7-272.5)
ALT (IU/L)	19 (11.2-31.2)
LDH (IU/L)	410 (244.25-690.50)
Procalcitonin (ng/mL)	3.1 (0.78-18)
Calcium (mg/dL)	7.4 (6.9-9.1)
Albumin (g/dL)	2.7 (1.9-3.1)
Glucose (mg/dL)	134 (110-190)
Creatinine (mg/dL)	1.2 (0.68-2.3)

Overall, 46 (56.8 %) patients survived while 35 (43.2 %) of the patients died during the course of the study (Table 3).

Table 3: Morbidities Observed During ICU Stay and Prognosis (n=81)

ICU-Associated Comorbidities	Frequency (%)
Septic shock / Sepsis	35 (43.2 %)
Hepatic dysfunction	14 (17.28 %)
Neutropenia	14 (17.28 %)
Renal Dysfunction	24 (29.63 %)
Renal Replacement Therapy	27 (33.33 %)
Mechanical Ventilation	54 (66.67 %)
Chemotherapy	08 (9.87 %)
Blood Transfusion	52 (64.2 %)
Central Venous Catheterization	28 (34.57 %)
Arterial Catheterization	41 (50.62 %)
Infection (proven or suspected)	30 (37 %)

DOI: https://doi.org/10.54393/pjhs.v7i6.3904

Bacterial Infection		28 (34.57 %)
Pulmonary Infection		29 (35.8 %)
Steroid Usage		59 (72.8 %)
Vasopressor Use		50 (61.72 %)
Final Outcome (Mortality)	Survived	46 (56.8 %)
	Died	35 (43.2 %)

Patients with hematological malignancies had a significantly longer hospital stay before ICU admission compared to those with solid tumors (6 vs. 2.5 days; p=0.01). Chemotherapy use was significantly higher in patients with solid tumors (41.98% vs. 28.4%; p<0.01). Sepsis/septic shock as a cause of ICU admission showed borderline significance between groups (39.5% vs. 24.7%; p=0.05) (Table 4).

Table 4: Cross Tabulation of Various Parameters According to Type of Cancers (n=81)

Variables		Solid Tumors	Hematological Malignancies	p-value
Age (years)		59 (37-69)	51.5 (34-61)	*0.050
Gender	Male	15 (18.5%)	18 (22.22%)	0.720
	Female	32 (39.5%)	16 (19.75%)	
Hospital stay before admission to ICU (days)		2.5 (1-9.5)	6 (1.5-12.5)	*0.010
Length of ICU stay (days)		4.5 (2-12)	4.5 (3.2-8.75)	0.100
Stage of Cancer	Recently diagnosed	11 (13.6%)	17 (21%)	0.560
	Complete or partial remission	9 (11.11%)	10 (12.35%)	
	Relapse or progressive disease	14 (17.28%)	12 (14.8%)	
	End stage	03 (3.7%)	05 (6.17 %)	
Performance Status	Good (ECOG 0-2)	40 (49.38%)	18 (22.22 %)	0.620
	Poor (ECOG 3 and 4)	10 (12.35%)	11 (13.58 %)	
Treatment	Chemo	34 (41.98%)	23 (28.4 %)	*<0.010
	Radiation	11 (13.58%)	09 (11.11 %)	
	Surgery	12 (14.8%)	10 (12.35 %)	
	Therapy < 30 days before ICU admit	28 (34.57%)	12 (14.8 %)	
Comorbidities	COPD	05 (6.17%)	04 (4.94 %)	0.550
	Diabetes mellitus	11 (13.58%)	10 (12.35 %)	
	Hypertension	09 (11.11%)	11 (13.58 %)	
	Cardiovascular diseases	04 (4.9 %)	08 (9.87 %)	
Reason for ICU Admission	Sepsis/ septic shock	32 (39.5 %)	20 (24.7 %)	*0.050
	Respiratory failure	30 (37 %)	17 (21 %)	
	Acute renal failure	12 (14.8 %)	15 (18.5 %)	
ICU-Associated Comorbidities	Renal Dysfunction	24 (29.63 %)	15 (18.5 %)	*<0.010
	Neutropenia	06 (7.4 %)	18 (22.22 %)	
	Thrombocytopenia	22 (27.2 %)	19 (23.46 %)	
	Mechanical ventilation	20 (24.7 %)	16 (19.75 %)	
	Hepatic Dysfunction	12 (14.8 %)	15 (18.5 %)	
	Vasopressors	18 (22.22 %)	10 (12.35 %)	
	>2 organ dysfunction	30 (37 %)	09 (11.11 %)	
	Infection	40 (49.4 %)	18 (22.22 %)	
Bacterial Infection		22 (27.2 %)	16 (19.75 %)	0.540
Fungal Infection		04 (4.9 %)	07 (8.64 %)	
Pulmonary Infection		38 (46.9 %)	19 (23.46 %)	
Bloodstream Infection		08 (9.87 %)	08 (9.87 %)	

On admission to the ICU, renal dysfunction was significantly more common in solid tumor patients (29.63% vs. 18.5%; p<0.01). Hematological parameters also differed significantly, with higher leukocyte counts (p=0.04) and platelet counts (p=0.05), while C-reactive protein levels were significantly elevated in hematological malignancies (p<0.01). During ICU stay, sepsis/septic shock remained significantly different between groups (24.7% vs. 18.5%; p<0.01). Final outcomes showed a significant difference in survival, with higher survival in patients with solid tumors (37% vs. 19.75%; p<0.01) (Table 5).

Table 5: Cross Tabulation of Various Parameters After Admission to ICU (n=81)

Variables	Solid Tumors	Hematological Malignancies	p-value
APACHE II score	20 (16-26)	24 (17-27)	0.440
GCS	14 (9-15)	14 (10-15)	0.950
SOFA score	8 (5-10)	9 (4-11)	0.620
Hemoglobin level (g/dL)	9.9 (8.1-10.2)	9.5 (7.9-9.9)	0.080
Leukocytes (/mm3)	7,250 (3375-12000)	8,850 (4750-14450)	*0.040
Thrombocytes (/mm3)	98,000 (48000-185000)	124,000 (42000-228000)	*0.050
C-reactive protein (mg/L)	110 (72.7-181)	180 (87-272.5)	*<0.010
ALT (IU/L)	17 (11.2-28.1)	20 (12.8-31.0)	0.500
LDH (IU/L)	420 (244.25-585)	430 (290-690)	0.730
Procalcitonin (ng/mL)	2.8 (0.78-1.65)	3.2 (0.8-1.8)	0.120
Calcium (mg/dL)	7.6 (6.9-8.8)	7.2 (6.9-9.1)	0.500
Albumin (g/dL)	2.5 (1.92-2.9)	2.5 (1.9-3)	0.780
Glucose (mg/dL)	128 (110-164)	137 (111-190)	0.230
Creatinine (mg/dL)	1.1 (0.78-1.9)	1.3 (0.68-2.3)	0.540
Morbidities during ICU stay			
Sepsis/septic shock	20 (24.7 %)	15 (18.5 %)	*<0.010
Neutropenia	06 (7.4 %)	08 (9.87 %)	
Hepatic dysfunction	07 (8.64 %)	07 (8.64 %)	
Renal dysfunction	16 (19.75 %)	08 (9.87 %)	
Renal replacement therapy	13 (16 %)	14 (17.3 %)	
Requirement of mechanical ventilation	38 (46.9 %)	16 (19.75 %)	
Chemotherapy in ICU	04 (4.9 %)	04 (4.9 %)	
Blood transfusion	23 (28.4 %)	29 (35.8 %)	
Central venous catheterization	16 (19.75 %)	12 (14.8 %)	
Arterial catheterization	22 (27.2 %)	19 (23.46 %)	
Suspected or culture-proven infection	16 (19.75 %)	14 (17.28 %)	
Bacterial Infection	18 (22.22 %)	10 (12.36 %)	
Pulmonary Infection	10 (12.35 %)	19 (23.46 %)	
Steroid use	31 (38.27 %)	28 (34.57 %)	

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Vasopressor use		31 (38.27 %)	19 (23.46 %)	
Final Outcome	Survived	30 (37 %)	16 (19.75 %)	*<0.010
	Died	20 (24.7 %)	15 (18.5 %)	0.230

DISCUSSION

Cancer patients tend to be more ill than non-cancerous patients, resultantly causing higher admissions into the ICU and an increase in hospital mortality rates. Likewise, the mortality rate in this study was 43 %, higher than the mean mortality rate reported in studies (32 %), with mortality among all ICU admission patients [15]. The difference in mortality rates can be owed to the fact that variations exist in terms of the composition of underlying diseases, the criteria used for admission and discharge of patients from the ICU, treatment decisions, and in implementing end-of-life decisions [16]. A significant difference was observed in this study between solid tumor patient group and hematological malignancy patient group in terms of median age (p=-0.05), length of hospital stay (p=-0.01), cancer treatment status (p<0.01), cause of ICU admission (p=-0.005), morbidities on ICU admission (p<0.001), leukocytes (p=-0.04), thrombocytes (p=-0.05), C-reactive protein (p<0.01), morbidities during ICU stay (p<0.001) and in the outcome of patients who survived (p<0.01). As the prevalence of cancer continues to rise globally, the demand for intensive care unit (ICU) admission among cancer patients has grown, necessitating a comprehensive understanding of the clinical features and prognostic factors associated with this unique population [17, 18]. Several studies have investigated the clinical features that characterize cancer patients requiring ICU admission [19, 20]. A retrospective analysis found that hematologic malignancies, particularly acute leukemia, were associated with a higher likelihood of ICU admission compared to solid tumors. This underscores the heterogeneity of cancer types and their distinct impact on critical illness [21]. Likewise, chemotherapy-induced complications have also emerged as significant contributors to ICU admissions among cancer patients. Studies have highlighted the role of treatment-related immunosuppression, suggesting a complex interplay between cancer therapies and susceptibility to severe infections [22]. A study demonstrated that higher Sequential Organ Failure Assessment (SOFA) scores on ICU admission were associated with increased mortality among cancer patients [23]. Similar to this study, the presence of sepsis further complicates the prognosis for cancer patients in the ICU. Recent meta-analyses underscored the association between sepsis and higher mortality rates, emphasizing the need for prompt recognition and targeted management of infectious complications. Additionally, the effectiveness of cancer treatment has been implicated as a pivotal determinant of outcomes [24]. A review highlighted the importance of considering treatment response and the impact of ongoing therapies on the overall prognosis of cancer patients admitted to the ICU. The type and stage of cancer play a crucial role in shaping the clinical course of critically ill cancer patients. Over half of the ICU-admitted patients in this study survived, potentially indicating the potential benefit of ICU care in selected patients. Published literature indicates mortality rates among ICU cancer patients tend to vary widely, ranging from 30 to 60 %. This depends upon the stage of disease and co-morbidities [22-24]. This research's mortality rate falls within the ranges of international literature.

Comprehensive data collection was one of the main highlights of this study. Comprehensive data enabled the performance of detailed subgroup analyses, identifying trends, exploring potential confounding variables, and strengthening the internal validity of the study. Since the prognostic values were not tested using multivariate analysis, the study cannot claim the predictive or prognostic outcomes of the patients. This study was limited by its single-center design and observational design, which might have affected generalizability. The relatively small sample size and lack of long-term follow-up restricted the ability to fully assess outcomes beyond ICU discharge. Additionally, heterogeneity in cancer types and prior treatments could have confounded the observed associations. Studies with higher sample sizes, having a multi-centered approach, would help in developing predictive models for ICU outcomes in cancer patients. Research should also explore interventions targeting early sepsis detection, organ dysfunction management, and optimized ICU resource allocation to improve survival in high-risk groups.

CONCLUSIONS

Cancer patients requiring ICU admission showed distinct clinical patterns based on malignancy type. Patients with hematological malignancies had longer pre-ICU hospital stays, higher inflammatory markers, and a greater burden of sepsis and organ dysfunction. In contrast, patients with solid tumors demonstrated better survival outcomes. These findings highlight the prognostic significance of malignancy type and associated clinical parameters in guiding risk stratification and ICU management.

Authors' Contribution

Conceptualization: RKS
Methodology: RKS
Formal analysis: AA, SAB, TK
Writing and Drafting: RKS, TK
Review and Editing: RKS, AA, SAB, TK

All authors approved the final manuscript and take responsibility for the integrity of the work

DOI: https://doi.org/10.54393/pjhs.v7i6.3904

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The authors received no financial support for the research, authorship and/or publication of this article.

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