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Clinical Value of Quantitative Scoring Nursing Intervention for Adverse Reactions in PD-1 Monoclonal Antibody Treatment

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Abstract: *Objective:* To monitor the incidence of immune-related adverse events (irAEs) in patients treated with immune checkpoint inhibitors (ICIs) and programmed cell death protein-1 (PD-1), and to evaluate the effectiveness of nursing interventions using a quantitative scoring system. *Methods:* A retrospective analysis was performed on 65 cancer patients who received PD-1 therapy at the Oncology Department of Baotou Cancer Hospital from December 2023 to December 2024. The study examined the clinical features and blood test results related to irAEs. The National Cancer Institute's Common Terminology Criteria for Adverse Events (NCI-CTCAE) was used to grade the severity of these events, which were classified into five levels. Based on the NCI-CTCAE scores, appropriate nursing measures were implemented, and a comprehensive risk assessment framework was developed. *Results:* The study group showed lower complication rates, overall incidence, and average hospital stay compared to the control group ($P < 0.05$). Among the 65 patients, twenty-eight (43.07%) experienced a total of 35 irAEs, with 2 (5.71%) being grade 3 or 4. The most frequent irAEs were dermatological conditions (34.29%), particularly rash with itching. The occurrence of irAEs did not correlate with patient gender, age, blood parameters (hemoglobin, white blood cell count, platelet count, etc.), or liver function ($P > 0.05$), but it was associated with tumor type ($P < 0.05$). *Conclusion:* PD-1 treatment is generally safe, with a low incidence of severe (grade 3 or higher) irAEs. Close monitoring is essential to ensure early detection, intervention, and management of irAEs, thereby maintaining a low level of adverse events and enhancing the safety and efficacy of PD-1 therapy. Implementing a quantitative risk scoring system for nursing care can decrease the rate of complications, enhance patient safety, and potentially reduce hospital stays and medical costs.

Keywords: Programmed cell death protein-1; Tumor; Adverse reactions; Quantitative rating; Nursing intervention; Clinical value research

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1. Introduction

Immune checkpoint inhibitors (ICIs), by inhibiting the suppressive regulatory molecules (i.e., checkpoints) of T-cell function on the surface of immune cells and tumor cells, can ensure the normal functioning of antigen-presenting cells (APCs), thereby stimulating the immune potential of T-cells and strengthening the immune response against tumors. Among the many T-cell checkpoints that may respond to this strategy, two specific target proteins, cytotoxic T-lymphocyte-associated antigen 4 (CTLA-4) and programmed death receptor-1 (PD-1), have been widely adopted and validated in clinical practice [1]. PD-1 immune checkpoint blockers are known as "broad-spectrum anticancer drugs" because they achieve antitumor effects by regulating the activity of the host immune system. They have demonstrated significant efficacy in the treatment of various tumors such as head and neck cancer, gastric cancer, melanoma, lymphoma, non-small cell lung cancer, liver cancer, renal cell carcinoma, colorectal cancer, squamous cell lung cancer, and urothelial carcinoma, and are being expanded into clinical trials for other tumor types. However, this approach is also associated with immune-related adverse events (irAEs) specific to tumor immunotherapy. The occurrence of irAEs stems from the activation of the body's immune system by immune checkpoint inhibitors, which can cause nonspecific damage to normal cells, tissues, and organs while treating tumors, inducing a series of adverse consequences [2]. The scope of irAEs covers almost all organ systems and may occur at any time during immunotherapy [3]. Asmar *et al.* revealed that anti-PD-1 antibodies can significantly improve the short-term efficacy and survival rate of patients with advanced cancer [4].

According to the NCI-CTCAE (National Cancer Institute - Common Terminology Criteria for Adverse Events) grading system, the severity of adverse events is subdivided into five levels. By carefully monitoring changes in the patient's condition, implementing appropriate nursing strategies, and enhancing understanding of irAEs symptoms, it can boost patients' belief in fighting the disease and promote their active cooperation with treatment. Quality nursing can not only improve treatment effects but also effectively reduce adverse events. Through targeted monitoring of the patient's condition, deepening understanding of irAEs symptoms, and improving patients' tolerance, medical staff should proactively provide professional knowledge guidance, psychological comfort, social assistance, and continuous nursing services to fully meet patients' nursing needs. This will optimize nursing quality, promote good cooperation between patients and treatment plans, and enhance their confidence in overcoming the disease. In clinical practice, programmed death receptor-1 (PD-1) inhibitors among immune checkpoint inhibitors (ICIs) have been widely used in the treatment of various malignancies. Therefore, in-depth exploration of adverse events (irAEs) associated with their treatment is of great significance for optimizing clinical strategies and improving the quality of life of patients with malignancies. This study is a retrospective exploration focusing on the occurrence of irAEs in 65 patients with different types of malignancies who received PD-1 treatment for a total of 200 times in the oncology department of Baotou Cancer Hospital from December 2023 to December 2024, and conducted a detailed clinical analysis.

2. Clinical data

2.1. General information

The study included 65 patients with malignant tumors who received PD-1 immunotherapy at Baotou Cancer Hospital from the end of 2023 to the end of 2024. The patients ranged in age from 34 to 88 years old, with 47 males and 18 females. The types of diseases are diverse, including 14 cases of liver cancer, 17 cases of lung cancer, 9 cases of colon cancer, 6 cases of kidney cancer, 4 cases of malignant melanoma, 3 cases each of cervical

cancer and gastric cancer, 2 cases each of ovarian cancer and esophageal cancer, and 1 case each of bladder cancer, Hodgkin's lymphoma, throat cancer, and tongue cancer. Each patient received an average of 3.08 PD-1 treatments, totaling 200 treatments. It is worth noting that this study strictly excluded patients with liver and kidney dysfunction. For a deeper analysis, the study also selected another 65 patients who are hospitalized in the palliative oncology department of Baotou Cancer Hospital during the same period as the control group.

The National Cancer Institute-Common Terminology Criteria for Adverse Events (NCI-CTCAE) scoring system is used for quantitative evaluation. Based on the severity of adverse reactions, the system classifies them into five levels, allowing for personalized nursing plans to be developed. Through timely adjustment and optimization of the scoring criteria, a comprehensive nursing risk assessment framework is been established. This framework aims to improve treatment effectiveness and reduce the occurrence of immune-related adverse events (irAEs) through high-quality nursing services. By carefully monitoring patients' conditions and enhancing understanding of immune-related adverse reactions, patients' tolerance can be improved. During this process, medical staff actively provide professional knowledge, psychological counseling, social resource integration, and continuous nursing services to fully meet patients' nursing needs. This aims to improve the quality of care, promote patients' treatment compliance, and enhance their confidence in fighting the disease.

2.2. Methods

2.2.1. Treatment

In this study, an immune checkpoint inhibitor (ICI) that is approved by the US Food and Drug Administration (FDA) is adopted, specifically nivolumab targeting programmed death receptor-1 (PD-1). The drug is administered intravenously at a dose of 3 mg per kilogram of body weight, once every two weeks. Treatment continued until disease progression is observed or unmanageable side effects occurred, at which point treatment is terminated.

Before initiating treatment, the research team provided comprehensive information about PD-1 targeted therapy to the patients and their families, including potential benefits, possible risks, and expected adverse reactions. All participating patients signed informed consent forms based on their full understanding. During the treatment phase, drug dosages strictly followed the product instructions, and dosing intervals are flexibly adjusted based on the recommendations in the instructions or the patients' actual follow-up treatment schedules. Adverse reactions are evaluated according to the Common Terminology Criteria for Adverse Events (CTCAE) version 5.0. Additionally, the implementation of this research project is formally approved by the Ethics Review Committee of Baotou Cancer Hospital.

2.2.2. Nursing care

According to the NCI-CTCAE grading system, targeted nursing plans are implemented based on the severity of adverse reactions, which are subdivided into five levels:

(1) Drug administration and nursing procedures

Use 0.9% sodium chloride solution as a diluting medium, gently stir the drug until it is completely dissolved, and avoid vigorous shaking to ensure drug stability. The preparation process should follow the principle of immediate use, and the time span from preparation to the start of infusion should not exceed four hours. During the infusion process, a sterile filtered infusion device should be used, and the infusion rate should be precisely controlled with an infusion pump. A single drug infusion strategy should be implemented, and mixing with other drugs is strictly prohibited. The entire infusion duration should be

maintained between thirty to sixty minutes. After the infusion is completed, use 0.9% sodium chloride solution to flush the tubing, and simultaneously implement ECG monitoring to comprehensively monitor the patient's vital signs.

(2) Nursing strategies for immune-mediated adverse reactions

Anti-PD-1 monoclonal antibody therapy may induce a wide range of immune-related adverse reactions that can affect almost all organ systems in the body, including but not limited to the skin system, gastrointestinal system, liver, kidney, visual organs, endocrine glands, and even the central and peripheral nervous systems.

(3) Nursing practices for thyroid dysfunction

Among patients receiving anti-PD-1 monoclonal antibody therapy, approximately 10% experience varying degrees of immune-mediated adverse reactions in the endocrine system, with hypothyroidism being particularly prominent, occurring in up to 11% of patients with a median onset period of approximately 2.9 months [5]. In the patient samples included in this study, five cases are diagnosed with hypothyroidism. Their blood test results revealed that free triiodothyronine (FT3) concentrations are generally below the normal range, fluctuating between 2.90 and 3.60 pmol/L, while thyroid-stimulating hormone (TSH) concentrations are significantly elevated, ranging from 5.16 to 81.99 mIU/L. These patients presented with symptoms such as chills, fatigue, lethargy, loss of appetite, hypoglycemia, nausea, and vomiting. Physicians recommended that patients take Euthyrox (levothyroxine sodium) and emphasized that patients should not change the medication dosage without consultation. Additionally, physicians explained the potential adverse reactions of the medication and the pathogenesis of hypothyroidism to patients and their families to alleviate their anxiety. After discharge, patients need to regularly monitor blood electrolytes and thyroid function indicators, and pay close attention to changes in their behavior and mental state. In case of symptoms related to hypothyroidism, they should seek medical attention and take corresponding treatment measures immediately. After effective treatment, the serum FT3 levels of these five patients returned to the normal range, fluctuating between 4.51 and 5.92 pmol/L, and their serum TSH levels also dropped to the normal range, ranging from 1.30 to 4.8 mIU/L.

(4) Nursing strategies for skin side effects

Among the various adverse reactions caused by immunotherapy, skin toxicity effects are particularly significant, tending to emerge around the fifth week of treatment [6]. Specifically, minor skin side effects are most common, with the incidence of rash fluctuating between 28% and 37%. In contrast, more severe skin reactions such as psoriasis and erythema multiforme are rare, typically affecting the limbs and trunk areas of patients. The root cause of symptoms such as rash and itching induced by anti-PD-1 monoclonal antibody therapy lies in the antibody's blockage of the interaction between tumor tissue and shared antigens in the skin [7]. On the eve of drug infusion, nursing staff need to fully explain the specific manifestations and symptoms of potential skin side effects to patients, so that they can be psychologically prepared and remain calm when the rash appears. Following medical advice, nursing staff should continuously administer anti-allergic agents such as dexamethasone and cimetidine via intravenous pumps. After administration, patients' skin conditions should be closely monitored, and nursing staff should listen patiently to patients' subjective feelings and feedback. Once a rash appears on the patient's skin, nursing staff should guide them to apply urea cream externally and record the initial time point, exact location, and symptom details of the skin side effects.

Additionally, nursing staff should advise patients to avoid squeezing blisters or pimples in the rash area to prevent skin breakage and infection. At the same time, patients are recommended to trim their nails to reduce the risk of infection due to scratching. It is crucial to maintain cleanliness and hygiene of the surrounding skin, which can be cleaned with neutral soap, but avoid using hot water for soaking. Choose soft and loosely fitted cotton clothing, and ensure that the bedding is clean and dry. When patients are engaged in outdoor activities, they should be careful to avoid direct sunlight exposure, as this may exacerbate skin side effects. For patients with allergic constitutions, nursing staff should remind them to moderately reduce their intake of beef, mutton, and seafood during medication to lower the risk of potential allergic reactions. At the same time, patients should be clearly informed that when local skin is affected by a rash, it usually does not leave lasting scar marks. Skin adverse reactions induced by anti-PD-1 monoclonal antibodies often exhibit a self-limiting characteristic.

Nursing staff should assume the responsibility of comforting patients' emotions, ensuring that they can receive treatment without worries, thereby effectively relieving their inner anxiety and unease. In the case population included in this study, a total of 4 individuals were observed to have skin adverse reactions. Specifically, two patients suffered from skin hemangioma, and no special intervention measures were taken. The symptoms gradually resolved spontaneously with the discontinuation of the drug. Another patient developed a rash accompanied by itching in the lower extremity area after receiving medication for the first time, but fortunately, it did not progress to ulceration or suppuration. The symptoms are significantly relieved after a week of external treatment with urea ointment. In addition, a patient encountered a recurrence of psoriasis after receiving the fourth medication and is subsequently transferred to another hospital for targeted treatment. After several treatments, the symptoms showed a trend of improvement.

(5) Nursing strategies for pulmonary diseases

When discussing nursing measures for immunotherapy-related pneumonia, it must be mentioned that the immune-related pneumonia that may be induced by the use of anti-PD1 monoclonal antibodies, whose main clinical manifestation is nonspecific interstitial pneumonia [8]. The onset time of such adverse reactions varies widely, typically ranging from 0.5 to 24.3 months after medication, with a median onset time concentrated between 2 to 2.6 months [9, 10]. Given this, nursing staff must maintain a high level of vigilance during the entire cycle of patients receiving drug treatment and closely monitor patients' vital signs. Once patients develop new cough symptoms or clinical manifestations such as dyspnea that may be related to impaired lung function, the nursing staff should immediately notify the attending physician and quickly arrange for the patient to undergo a chest CT scan to comprehensively evaluate and analyze the lung condition.

Among the patient population, one patient unfortunately developed interstitial lung disease after the second drug treatment, with clinical manifestations including worsened cough and shortness of breath induced by physical activity. With the help of computed tomography (CT) technology, the medical team observed areas of ground-glass opacity in the lungs. As a result, the doctor quickly discontinued the patient's medication and initiated high-dose glucocorticoid therapy. After two weeks of careful treatment, the patient's symptoms gradually improved. Additionally, another patient developed a complex condition of interstitial lung disease accompanied by heart failure after the fourth drug administration. He reported a strong feeling of chest compression, difficulty breathing, and could only breathe with difficulty while

sitting upright. CT scan results showed reticular and nodular images in the lungs, accompanied by fluid retention in the pleural and pericardial cavities. In response to this situation, the doctor performed thoracentesis to reduce the pressure of the fluid accumulation, provided comprehensive treatment measures including strengthening the heart, promoting diuresis, and fighting infection, and supplemented with adequate glucocorticoids. After three weeks of systematic treatment, the patient's condition also showed a gradual improvement.

(6) Nursing strategies for fever symptoms

Fever is a common immune-related adverse event, and its pathogenesis involves the release of cytokines and nonspecific activation of immune responses. Before treatment with programmed death receptor-1 (PD-1) monoclonal antibodies, standard procedures require temperature monitoring, and continuous monitoring of dynamic changes in body temperature during and after drug infusion. In case of high fever symptoms, physical methods should be prioritized for cooling treatment, and drug cooling such as antipyretic and analgesic tablets, indomethacin suppositories, and compound aminopyrine injections can be implemented when necessary.

Simultaneously, patients should be encouraged to increase water intake and provided with a nutritious diet rich in calories, protein, and vitamins. Additionally, it is necessary to ensure good air circulation, a fresh and pleasant environment in the ward, and appropriate temperature control to prevent patients from getting chilled again. In this group of cases, one patient developed transient fever during the drug infusion process, with a temperature rise to 38 °C. The medical staff quickly guided the patient to increase hot water intake and assisted with warm water sponging care, and the patient's temperature gradually returned to the normal range.

2.3. Statistical analysis

The collected data is analyzed using the SPSS statistical software package (version 22.0). For categorical variables, percentages is used for description. To compare differences between groups, chi-square (χ^2) test is performed. The level of statistical significance is set at a P-value less than 0.05, which is used as the criterion to determine whether the differences between groups are statistically significant.

3. Results

3.1. Occurrence of irAEs

Among a total of 65 cases (accounting for 43.08% of the patients), the occurrence of 75 immune-related adverse events (irAEs) was observed. Among these, two cases (accounting for 5.71%) were classified as severe irAEs of grade 3 or 4. The most frequent type of irAEs was skin system disorders (accounting for 34.29%), and most of them manifested as rash phenomena accompanied by itching symptoms (see Table 1 for details). Based on the consensus guidelines published by the American Society of Clinical Oncology, the recommended management for low-grade irAEs is to suspend treatment with immune checkpoint inhibitors (ICIs) and implement continuous disease monitoring [11]. For grade 2 or more severe irAEs, the use of steroid hormones is recommended as a treatment approach. The results are shown in **Table 1**.

Table 1. Occurrence of 35 adverse reactions in 28 patients

Class	Total number of times	Percentage %	Level 1–2 / times	Level 3 > / times
Skin	12	34.29	11	1
Erythra	6			
Pruritus	4			
Spiloplaxia	1			
Acute posterior ganglionitis	1			
Gastrointestinal reaction	4	11.43	4	0
Diarrhoea	2			
Stomatitis	2			
Renal inadequacy	2	5.71	2	0
Pneumonia	2	5.71	2	0
Pneumonia	2	5.71	2	0
Hepatobiliary reaction	9	25.71	8	1
Other	6	17.14	6	0
Cerebritis	1			
Diabetes mellitus	2			
Initis	2			
Neuroinflammation	1			

3.2. Exploration of the association between patient baseline characteristics and irAEs

In statistical analysis, we found that the occurrence of irAEs did not show a significant correlation with patient gender ratio, age level, blood routine indicators (including hemoglobin level, white blood cell count, platelet count, etc.), and liver function status (all *P*-values > 0.05). However, it is worth noting that there was a statistically significant difference between tumor classification and the occurrence of irAEs (*P*-value < 0.05). The results are shown in **Table 2**.

Table 2. Comparison of other clinical characteristics between patients with and without irAEs

Baseline data	Happen irAEs (N = 28) / case	No irAEs have occurred (N. = 28) / case	χ^2	*P*
Sex			0.710	0.40
Man	22	32		
Woman	6	5		
Age / year			0.288	0.60
> 60	22	31		
< 60	6	6		
Hemoglobin			1.837	0.40
Lower than normal	13	12		
Normal value	6	13		

Table 2 (Continued)

Baseline data	Happen irAEs (N = 28) / case	No irAEs have occurred (N. = 28) / case	χ^2	*P*
Higher than normal	9	12		
Leucocyte count			1.030	0.59
Lower than normal	6	12		
Normal value	14	15		
Higher than normal	8	10		
Platelet count			0.274	0.87
Lower than normal	6	10		
Normal value	12	15		
Higher than normal	10	12		
Absolute values of the lymphocytes			1.403	0.24
Normal value	11	19		
Lower than normal	17	16		
Absolute values of the monocytes			0.371	0.54
Normal value	15	17		
Lower than normal	13	20		
Albumin			0.010	0.92
Normal value	11	15		
Lower than normal	17	22		
Lactate dehydrogenase			0.014	0.91
Normal value	17	23		
Lower than normal	11	14		
Tumor type			14.15	0.03
Gastric cancer	4	2		
Carcinoma of the lungs	15	6		
Renal cell carcinoma, and the urinary tract	4	12		
Skin and bladder cancer	2	6		
Malignant mela noma	1	3		
Head and Neck Cancers	1	4		
Malignant pleural mesothelioma	1	4		

4. Discussion

Immune checkpoint blockade therapy has opened up broad prospects in the field of oncology treatment. However, along with its significant efficacy, it also induces a series of side effects mediated by non-specific immune overactivation, which are often referred to as immune-related adverse events (irAEs) in medical literature [12].

Although cases of severe irAEs are relatively rare, without timely and appropriate intervention measures, such events can pose a potential threat to life. Studies have shown that among patients treated with PD-1/PD-L1 and CTLA-4 inhibitors, 15% and 20% experienced ≥ 3 grade irAEs during immunotherapy, respectively [13]. The timing of irAEs is uncertain, as they can occur during treatment or at any time after treatment discontinuation.

Most cases occur within a 3-to-6-month window after the initial administration, but recurrence within one year of treatment is not uncommon [14]. irAEs can affect any tissue or organ in the body, with common sites reported in the literature including the lungs (5% to 53%), skin (34% to 45%), gastrointestinal tract (less than 19%), endocrine system (5% to 10%), liver (5%), as well as rheumatic/skeletal muscle lesions (15%) and infusion-related reactions (10%). Comparatively, involvement of the heart (less than 1%), nervous system (6.1%), eyes (less than 1%), blood system, and kidneys (less than 5%) is less common [15].

In this study, the overall incidence of irAEs was recorded as 43.08%, which is similar to previously reported values [16]. Among the study samples, skin diseases were the most common irAEs, especially rashes with dry skin and itching symptoms. Only one patient experienced grade 3 or higher skin lesions. In terms of severity, most skin disease patients can be effectively managed through topical moisturizers, oral antihistamines, and topical steroid hormones. In clinical practice, reducing the dose of immune checkpoint inhibitors (ICIs) or discontinuing treatment to prevent irAEs should be done with caution. Healthcare professionals need to maintain high vigilance to identify and scientifically manage irAEs early, thus ensuring the safety and effectiveness of treatment.

In the treatment of malignant tumors, compared to traditional chemotherapy, the use of anti-PD-1/PD-L1 therapy induces adverse events with a lower incidence, better patient tolerance, and rare fatal cases. Studies by Zhang *et al.* have revealed a significant positive correlation between the frequency of immune-related adverse events (irAEs) and tumor treatment efficacy and patient survival time [17]. Given the rapid onset of irAEs, timely medical intervention and care are particularly important, especially for elderly patient populations, who require meticulous monitoring of these potential toxic reactions to effectively prevent potential irAEs. Xu *et al.*, through a comprehensive review of recent advances in PD-1 inhibitor-related immune adverse reactions, concluded that PD-1-related irAEs are characterized by randomness, widespread involvement, and difficulty in control [16]. Therefore, it is essential to strengthen real-time detection mechanisms, take early intervention measures, and thoroughly explain relevant risks to patients before medication, ensuring their informed consent.

In summary, when applying immune checkpoint inhibitors (ICIs) in clinical practice, physicians should maintain high vigilance regarding adverse reactions while striving to improve anti-tumor efficacy. Clinicians should be proficient in diagnosing various irAEs and implementing the most effective treatment strategies, aiming for early detection, intervention, and treatment. This approach can control the severity of irAEs, ensuring the safety of ICIs in clinical applications, thereby extending the survival of cancer patients and enhancing treatment effectiveness.

5. Conclusion

Anti-programmed death receptor-1 (PD-1) monoclonal antibodies have demonstrated remarkable therapeutic efficacy for patients with advanced lung cancer, offering a new ray of hope for this patient population [18]. However, while enjoying the benefits of this treatment, a series of immune-mediated adverse reactions have also emerged, highlighting the importance of effective nursing strategies. Professional nursing intervention can help patients identify and avoid potential adverse reactions, teach self-monitoring skills, and ensure that once symptoms

appear, patients can closely collaborate with the medical team to quickly implement appropriate intervention measures, thereby optimizing the management of adverse reactions.

The core of nursing work focuses on the following aspects: Before treatment, nursing staff need to provide detailed education and guidance to patients and their families, provide necessary psychological comfort, enhance their understanding of the treatment process, and reduce unnecessary psychological burden. During the drug preparation stage, nursing staff must follow strict operating procedures, precisely control the infusion time and rate, and ensure the safety of the medication process. During treatment, patients' vital signs are continuously monitored using electrocardiographic monitoring equipment to capture any abnormal signs as early as possible. Additionally, nursing staff need to listen carefully to every complaint from patients, immediately notify doctors and handle any adverse reaction signs properly, and keep detailed records to lay a solid foundation for subsequent clinical decisions. It is worth noting that due to the limited sample size of this study, it may not cover all possible immune-related adverse reactions caused by PD-1 monoclonal antibodies.

Therefore, nursing staff should continue to pay attention to new trends in immune adverse reactions in clinical practice, continuously accumulate nursing wisdom, deepen the practice of detailed nursing, and gradually optimize nursing plans. Currently, the influence of anti-PD-1 monoclonal antibodies is expanding in clinical practice. While celebrating their efficacy, equal emphasis needs to be placed on medication safety, avoiding interference from severe adverse reactions during the treatment journey. Only in this way can it be ensured that patients obtain maximum benefits from treatment.

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