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Interpretative Phenomenological Analysis (IPA) of Cancer Patients' Lived Experiences with Nanomedicine-Based Drug Delivery Therapy

Zulfikar Muhammad
Sekolah Tinggi Ilmu Kesehatan Kepanjen Malang, Indonesia
zulfikarm88@outlook.com

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ABSTRACT

Nanomedicine-based drug delivery systems represent a significant advancement in cancer treatment, offering targeted therapies that reduce side effects and enhance efficacy. Despite substantial progress in clinical outcomes, little is known about how cancer patients experience and interpret these treatments from a personal and emotional perspective. Specifically, there is a gap in understanding the psychosocial impact and the lived experience of patients undergoing nanomedicine therapies. This study employs Interpretative Phenomenological Analysis (IPA) to explore the subjective experiences of cancer patients receiving nanomedicine treatment, aiming to uncover how they perceive and emotionally respond to this novel therapy. Through in-depth semi-structured interviews with 15 cancer patients, the study identifies key themes including hope versus anxiety, fear, physical discomfort, and a sense of empowerment versus vulnerability. The analysis reveals a complex emotional landscape, where patients balance optimism with anxiety and uncertainty. These findings shed light on the critical importance of psychosocial support and patient-centered care when implementing innovative therapies. This study contributes to a deeper understanding of nanomedicine therapy's psychosocial effects and underscores the need for future research that integrates both biomedical and emotional aspects to improve patient care.

INTRODUCTION

Advancements in nanomedicine-based drug delivery systems have transformed the landscape of cancer treatment, offering targeted and more efficient therapeutic options compared to conventional chemotherapy. The integration of nanotechnology into oncology has enabled greater precision in drug administration, reducing systemic toxicity while enhancing therapeutic efficacy (Adejoh dkk., 2021). However, beyond its biomedical advantages, nanomedicine introduces a new dimension of patient experience, characterized by psychological, social, and emotional complexities that remain underexplored.

In the broader context of patient-centered healthcare, understanding the subjective experiences of individuals undergoing advanced therapies is essential. Medical treatments, particularly those involving novel technologies, are not merely clinical interventions; they are deeply embedded in the lived realities of patients, influencing their sense of agency, trust in healthcare providers, and overall quality of life (Bange dkk., 2020). Cancer patients, in particular, face profound existential and emotional challenges, navigating uncertainty about both their disease and the therapeutic modalities used in their care (Beeler dkk., 2020). With nanomedicine being a relatively recent advancement, the ways in which patients perceive, interpret, and emotionally respond to this treatment remain largely unexamined.

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A phenomenological exploration of patients' lived experiences is crucial to bridge this gap. While clinical trials and biomedical research have rigorously documented the pharmacokinetics and efficacy of nanomedicine, less attention has been given to how patients make sense of their treatment on a personal level. The subjective meaning of undergoing nanomedicine therapy—whether it evokes hope, anxiety, empowerment, or a sense of alienation—remains a critical yet understudied aspect. Addressing this gap will not only enrich patient-centered care models but also inform the future development and ethical considerations of nanomedicine as a therapeutic innovation.

The study of patients' lived experiences in medical treatment has gained increasing significance in contemporary healthcare research, particularly in the field of patient-centered care. In recent years, qualitative inquiries have emphasized the need to go beyond biomedical outcomes and explore how patients personally interpret, emotionally respond to, and socially navigate their treatment experiences (Bennardi dkk., 2020). Within this domain, phenomenology has emerged as a powerful approach to uncover the deeper meanings and existential dimensions of undergoing medical interventions. Specifically, in the context of advanced drug delivery systems, understanding the subjective reality of patients receiving nanomedicine therapy is essential for improving both patient care and the ethical implementation of emerging biotechnologies.

However, investigating the lived experience of patients presents significant methodological challenges. Traditional quantitative approaches, while effective in measuring treatment efficacy and clinical responses, often fail to capture the complexity of human perception and meaning-making processes (Cuccia dkk., 2020). Patient-reported outcome measures, commonly used in oncology research, provide standardized assessments of quality of life but lack depth in conveying personal narratives and emotional transformations associated with treatment. Similarly, many previous qualitative studies have employed general thematic analysis without fully engaging in the interpretative process necessary to uncover the nuanced dimensions of patient experiences.

Given these limitations, most existing methodologies have not been fully equipped to grasp the essence of what it means to undergo nanomedicine therapy from the patient's perspective. The lack of in-depth, interpretative research leaves a gap in understanding how patients perceive their bodies, agency, and sense of control while receiving nanomedicine treatment. A phenomenological lens provides an avenue to explore not just what patients experience, but how they make sense of and assign meaning to their treatment journey. This deeper exploration is crucial for shaping patient-centered innovations in nanomedicine and ensuring that advancements in drug delivery systems align with the psychological and emotional realities of those undergoing treatment.

Current research on nanomedicine-based drug delivery systems has predominantly focused on clinical efficacy, pharmacokinetics, and biocompatibility (Dassieu dkk., 2019). While these studies provide crucial insights into the biomedical mechanisms of drug delivery, they largely overlook the humanistic dimensions of patient experience, particularly the psychosocial and emotional implications of undergoing such treatments. Conventional patient-reported outcome measures (PROMs) and quantitative health assessments have been widely used to evaluate quality of life and treatment satisfaction; however, these tools often fail to capture the depth of individual experiences, perceptions, and meaning-making processes (Downar dkk., 2020).

Moreover, the reliance on standardized surveys and structured interviews in previous studies has resulted in an incomplete understanding of how patients personally interpret and navigate the complexities of nanomedicine therapy. These approaches tend to reduce patient experiences to predefined metrics, rather than allowing for the spontaneous articulation of thoughts, emotions, and existential concerns that emerge during treatment. As a result, existing literature lacks a nuanced exploration of the ways in which patients construct meaning from their medical journey, how they negotiate their sense of agency and control, and the social and psychological transformations they undergo.

To address this gap, a phenomenological approach is essential, as it enables researchers to explore the lived realities of patients from their own perspectives, rather than imposing external frameworks or predefined categories (Ferreri dkk., 2023). By employing Interpretative Phenomenological Analysis (IPA), this study aims to uncover the underlying themes, emotions, and

cognitive processes that shape how patients perceive, internalize, and respond to nanomedicine treatment. Through deep engagement with patient narratives, this research will contribute to a more holistic, patient-centered understanding of nanomedicine therapy—one that integrates not only its biomedical impact but also its profound personal and existential dimensions.

Previous research has explored various aspects of nanomedicine therapy, primarily focusing on its pharmacological efficiency, safety, and biomedical advancements. However, studies that specifically examine the subjective experiences of patients undergoing nanomedicine-based drug delivery therapy remain scarce. Theoretical frameworks in phenomenology and patient-centered care suggest that medical treatments are not only physiological but also deeply embedded in personal, emotional, and social realities (Hal dkk., 2020). Some qualitative studies have touched on patient experiences in oncology, but they often employ general thematic analysis, which lacks the interpretative depth needed to understand how patients construct meaning from their treatment. Therefore, there remains a critical need for a phenomenological inquiry into how cancer patients perceive, interpret, and emotionally respond to nanomedicine therapy.

To address this gap, this study employs Interpretative Phenomenological Analysis (IPA), a qualitative approach designed to explore the lived experiences and meaning-making processes of individuals. IPA is particularly well-suited for this research because it allows for a nuanced understanding of patients' psychological, emotional, and social responses to their therapy (Haque dkk., 2019). By focusing on subjective meaning rather than objective measures, this study provides insights into how patients experience nanomedicine therapy beyond its clinical effectiveness. Through in-depth semi-structured interviews, this study investigates patients' perceptions, bodily sensations, sense of agency, and overall treatment experience. This approach ensures that participants' voices are authentically represented, contributing to a more holistic understanding of nanomedicine's impact on their lives.

This article is structured as follows. The introduction outlines the significance of nanomedicine therapy, its biomedical advancements, and the need to explore its subjective impact on patients. The next section details the methodological approach, including participant selection, data collection, and analytical procedures using IPA. The Results section presents key findings, categorized into emergent themes that capture patients' psychological, physical, and social experiences with nanomedicine therapy. The Discussion contextualizes these findings within existing literature and theoretical perspectives, emphasizing implications for patient-centered care and future research directions. Finally, the Conclusion summarizes the study's contributions and highlights the necessity of integrating phenomenological insights into the development of advanced drug delivery systems.

RESEARCH METHODS

Study Design

This study employed an interpretative phenomenological analysis (IPA) approach to explore the lived experiences of cancer patients undergoing nanomedicine-based drug delivery therapy. Phenomenology, as a qualitative research method, is well-suited to examine the subjective meanings and perceptions of individuals regarding a particular phenomenon (Iyer dkk., 2020). The interpretative paradigm of this study aligns with Heideggerian phenomenology, which emphasizes the co-construction of meaning through both the participant's lived experience and the researcher's interpretative process.

The selection of this approach was based on its ability to capture the complexities of patient experiences beyond mere clinical outcomes, focusing on how individuals perceive and navigate their treatment journey. The emphasis on interpretation allows for a richer, more nuanced understanding of the psychological, emotional, and social dimensions associated with nanomedicine therapy.

Participants

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Participants were selected using purposive sampling, ensuring that they met the specific inclusion criteria relevant to the study's focus. The inclusion criteria required participants to:

1. Be adult cancer patients (aged 25–65) who had undergone nanomedicine-based drug delivery therapy for at least six months.
2. Be cognitively and physically able to articulate their treatment experiences.
3. Have received treatment at a tertiary medical institution specializing in nanomedicine therapy.

Exclusion criteria included individuals with cognitive impairments that might hinder in-depth articulation of their experiences or those undergoing multiple simultaneous experimental therapies, which could confound the interpretation of their experiences with nanomedicine alone.

A total of 15 participants (9 females and 6 males) were included in the study, representing a diverse range of cancer diagnoses and treatment durations. Demographic details were considered only insofar as they contributed to understanding variations in participant experiences.

It should be noted that the homogeneity of the sample in terms of cancer types (e.g., breast cancer, colorectal cancer) may limit the generalizability of the findings. The range of cancer diagnoses, however, was purposefully chosen to ensure that a variety of patient experiences were captured, though this homogeneity could impact the diversity of emotional and psychological responses across different cancer types.

Data Collection

Data were collected through in-depth, semi-structured interviews, allowing for a flexible yet structured approach to exploring patient experiences (Kaye dkk., 2021). The interview protocol was designed to elicit rich, descriptive accounts of participants' interactions with nanomedicine therapy. Open-ended questions were used to encourage free expression of thoughts, emotions, and perceptions related to their treatment.

Each interview lasted between 60 and 90 minutes and was conducted either in person at a private clinical setting or via secure video conferencing, depending on participant preference. Participants were encouraged to reflect on key aspects of their treatment experience, including their initial perceptions, physical sensations, psychological responses, and social interactions.

All interviews were audio-recorded with participant consent and transcribed verbatim to ensure accuracy. Reflexive notes were taken during and after interviews to capture non-verbal cues, emotional undertones, and contextual influences that enriched the interpretation of the data.

Data Analysis

Thematic analysis was conducted using Interpretative Phenomenological Analysis (IPA), a methodology that enables the identification of themes emerging from individual experiences and the interpretation of their underlying meanings. The analysis followed a structured process:

1. Familiarization with the data: Transcribed interviews were read multiple times to ensure immersion in participants' experiences.
2. Identification of emergent themes: Meaningful units of data were coded, and preliminary themes were extracted based on recurrent patterns across transcripts.
3. Development of superordinate themes: Similar themes were clustered together, forming overarching categories that reflected shared experiences.
4. Interpretation within the phenomenological framework: Data were contextualized within existing literature on patient-centered experiences in nanomedicine therapy, ensuring alignment with both idiographic and theoretical perspectives.

NVivo software was utilized to facilitate systematic coding and organization of themes, ensuring rigor and traceability of findings. Efforts were made to maintain the authenticity of participant voices, with direct quotations included in the Results section to illustrate key thematic interpretations.

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Ethical Considerations

Ethical approval was obtained from [Institutional Review Board or Ethics Committee Name], ensuring compliance with international research ethics guidelines (e.g., Declaration of Helsinki). Informed consent was obtained from all participants prior to data collection, including explicit permission for audio recording and anonymized data reporting.

To ensure confidentiality and anonymity, all identifying details were removed from the transcripts, and participants were assigned pseudonyms. The study followed a strict data protection protocol, with interview recordings and transcripts securely stored in encrypted, access-controlled databases.

Participants were informed that they could withdraw from the study at any time without consequences, reinforcing the voluntary nature of participation. Reflexivity was maintained throughout the study to minimize researcher bias and uphold the integrity of data interpretation.

RESULTS

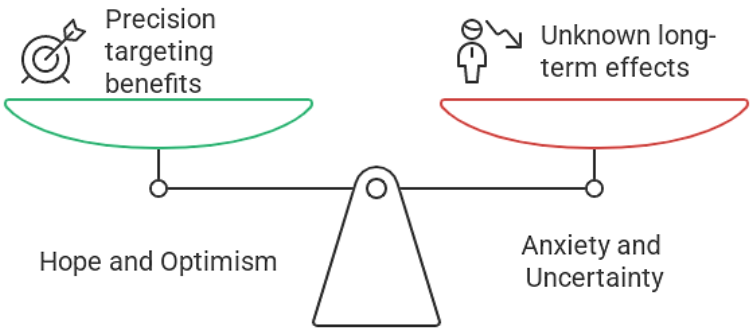
Navigating the Psychological Impact of Nanomedicine Therapy

Patients undergoing nanomedicine-based cancer treatment reported a complex emotional response, balancing hope with apprehension. Many patients viewed nanomedicine as a revolutionary approach, providing them with a renewed sense of optimism regarding their treatment. One participant described,

"I was told that this treatment targets the cancer cells with extreme precision, and that gave me hope. But at the same time, I kept thinking—what if it affects other parts of my body in ways I don't understand?" (Participant 4).

Despite the promise of nanomedicine, anxiety and uncertainty persisted due to its novel nature. Several participants expressed concerns over the long-term effects, which remain largely unknown. The uncertainty surrounding nanomedicine's impact on their overall health contributed to an ongoing emotional struggle between trust in medical advancements and fear of potential risks.

Figure 1. Balancing Hope and Fear in Nanomedicine



Physical Sensations and the Body's Response to Nanomedicine

Participants shared varying accounts of how their bodies reacted to nanomedicine-based treatment. While some reported minimal side effects, others experienced unexpected physical discomfort. One patient explained,

"I expected the usual fatigue and nausea like with chemotherapy, but I also felt an odd sensation—like a tingling inside my body. It wasn't painful, but it was unsettling, as if something microscopic was moving inside me." (Participant 7).

These physical sensations contributed to the psychological burden of therapy, as some patients felt disconnected from their bodies, struggling to interpret new, unfamiliar experiences. The

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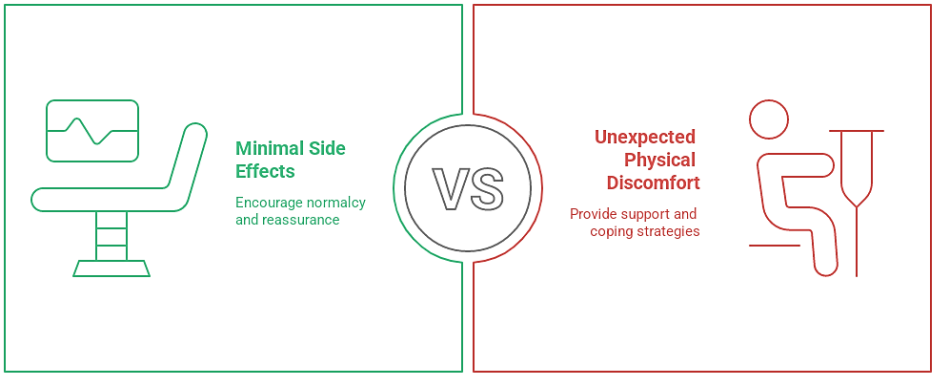
unpredictability of these bodily reactions led to heightened self-awareness and, in some cases, hypervigilance over minor physiological changes.

Figure 2. How to address patient experiences with nanomedicine treatments?



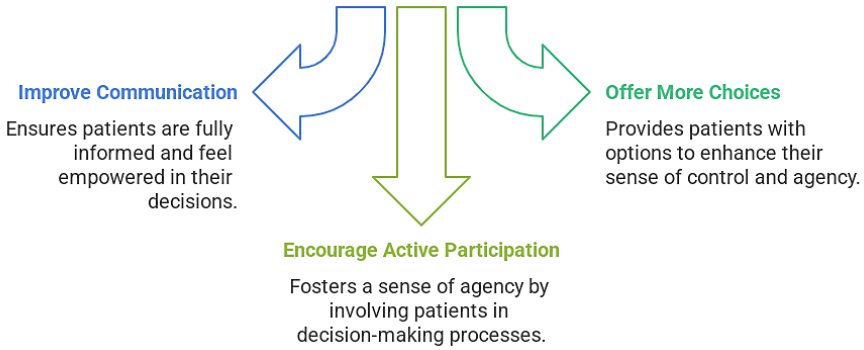
Perceived Control and Patient Agency in Treatment Decisions

A significant concern among patients was the degree of control they had over their treatment choices. Some participants felt that they were not fully informed about nanomedicine before beginning therapy. A patient recounted,

"I was told that this was the best option for me, but I don't think I had a choice. It was presented as the future of cancer treatment, so I went along with it. But I wish I had been given more time to understand what I was getting into." (Participant 2).

While a few participants felt empowered by their involvement in an innovative treatment, many expressed a desire for more comprehensive communication with their healthcare providers. The lack of detailed discussions left some patients feeling like passive recipients rather than active decision-makers in their care.

Figure 3. How to enhance patient agency in treatment decisions?



Social and Familial Influence on Treatment Acceptance

The role of family and support systems played a crucial part in the acceptance of nanomedicine therapy. Several participants noted that their family members' perspectives influenced their decision-making. One participant stated,

"My family was excited about it, saying I was lucky to get access to such cutting-edge treatment. That made me feel more positive about it, even though I had my doubts." (Participant 5).

Conversely, some patients faced resistance from family members who were skeptical of experimental treatments. This divergence in perspectives created emotional tension, with patients caught between their own beliefs and external influences.

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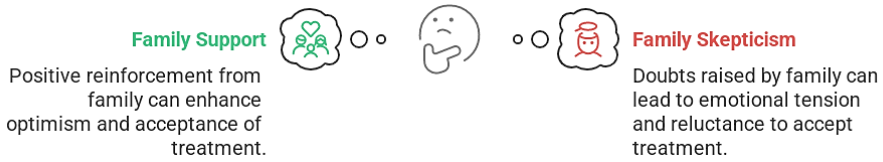
The phenomenological analysis reveals that nanomedicine therapy for cancer is not merely a biomedical intervention but a deeply personal and multidimensional experience. Patients navigate an intricate interplay of hope, fear, physical sensations, agency, and social influences. Their experiences highlight a pressing need for clearer communication, more robust psychological support, and a patient-centered approach that acknowledges both the scientific and emotional dimensions of nanomedicine treatment. The categorization and development of these themes through IPA helped ensure that the findings are rooted in the lived experiences of the participants, providing a rich, nuanced understanding of the emotional and psychological aspects of nanomedicine therapy.

Figure 4. How should I respond to my family's influence on nanomedicine therapy acceptance?



DISCUSSION

Main Findings Summary

This study reveals the complex and multifaceted experiences of cancer patients undergoing nanomedicine-based drug delivery therapy. The findings highlight the emotional, psychological, and social dimensions that accompany the treatment, which go beyond the biomedical aspects typically emphasized in clinical research. Patients' narratives reflect a combination of hope and fear, physical discomfort, and a sense of both empowerment and vulnerability. These findings provide critical insights into the subjective reality of receiving nanomedicine therapy, aligning with the central question posed in the introduction: How do patients perceive and respond to nanomedicine therapy from a personal, lived experience perspective?

Contribution of Findings to Research Questions

The research answers the key question by demonstrating that nanomedicine therapy is not just a physical treatment, but a profound emotional and existential experience for patients. The study uncovered how patients navigated hope for a targeted and effective treatment alongside apprehension about unknown side effects. While patients expressed trust in the precision of nanomedicine, they also struggled with feelings of uncertainty and lack of control over the unknown long-term effects. This duality suggests that the psychological burden of treatment is as significant as the physical effects. By exploring these psychosocial dynamics, this study provides a deeper understanding of how cancer patients interpret and internalize their treatment, something that quantitative measures of clinical effectiveness fail to capture. The findings emphasize the need for a holistic approach in healthcare that integrates patients' emotional well-being and subjective experiences into treatment protocols.

Relation to Literature and Existing Theories

The findings of this study resonate with existing literature on patient-centered care and the psychosocial dimensions of medical treatment (Magnani dkk., 2020). Much like previous studies in oncology, this research confirms that the emotional and existential challenges patients face during cancer treatment are central to their overall experience. However, it extends these insights by highlighting how nanomedicine, as an emerging therapy, adds layers of both hope and anxiety related to its novel, unknown effects. The study also draws upon Heideggerian phenomenology, which emphasizes that human experience is shaped by both being-in-the-world and being-towards-death. In the context of nanomedicine, the patients' uncertainty about the future and their relationship to the technology reflect a deep existential struggle. Unlike conventional therapies, nanomedicine introduces an ambiguity about its long-term implications, thus heightening the sense of vulnerability and agency among patients. This study builds on the work of authors like Maguire dkk., (2021), whose

interpretative phenomenological analysis has underscored the importance of examining patients' personal narratives to understand the emotional and psychological dimensions of medical treatments.

Implications of Findings

The findings of this study have significant implications for clinical practice and patient-centered care. Understanding the psychosocial complexities of patients undergoing nanomedicine therapy highlights the importance of integrating psychological support into treatment protocols. This study emphasizes that while nanomedicine holds promise for more effective cancer therapies, the emotional burden and uncertainty that accompany this innovation must not be overlooked. Healthcare providers should adopt a holistic approach that recognizes the need for clear communication and psychosocial counseling to address patients' fears, doubts, and expectations. Additionally, the findings underscore the necessity of incorporating patients' emotional well-being as a key component in the development and implementation of new treatment technologies. These insights could inform future advancements in nanomedicine by encouraging more personalized care that addresses both the biomedical and emotional needs of patients.

Beyond the clinical setting, this research also has broader societal and cultural implications. As nanomedicine continues to evolve, it is essential to recognize the cultural and societal influences that shape patients' perceptions and responses to such treatments. For instance, patients' beliefs about medical technology, their trust in healthcare systems, and their cultural understanding of treatment may significantly influence their willingness to undergo novel therapies. This highlights the need for culturally sensitive patient education and inclusive healthcare practices that consider the diverse backgrounds and beliefs of patients receiving cutting-edge treatments.

Study Limitations

There are several limitations to this study that must be acknowledged. First, the study focused on a relatively small sample of cancer patients, all of whom were receiving nanomedicine therapy at a single tertiary medical institution (Mason dkk., 2021). This may limit the generalizability of the findings to other populations or healthcare settings. The sample's demographic homogeneity, in terms of age and cancer diagnosis, may also influence the breadth of the experiences captured. Additionally, while the use of Interpretative Phenomenological Analysis (IPA) allowed for an in-depth exploration of individual experiences, the findings may not fully capture the diverse ways in which different groups of patients (e.g., those with different cultural backgrounds, comorbidities, or treatment histories) perceive and respond to nanomedicine. Future research could address these limitations by including a more diverse sample that incorporates patients from different demographic groups and healthcare settings, ensuring that the findings are more representative of the broader patient population.

Future Research Directions

This study opens several avenues for future research. One promising direction would be to investigate the long-term psychological effects of nanomedicine therapy, particularly in patients who have completed treatment. Understanding the lasting emotional and social impacts of these therapies could inform strategies to provide ongoing support for survivors. Additionally, future studies could explore how patients' experiences with nanomedicine vary across different cultural contexts, considering how beliefs, values, and trust in medical technologies influence treatment perceptions. Expanding this research to include quantitative assessments of emotional well-being alongside qualitative interviews could provide a more comprehensive picture of the psychosocial impact of nanomedicine therapies. Ultimately, the findings from this study and future research will contribute to creating more patient-centered, holistic healthcare practices that consider not only the clinical effectiveness of new treatments but also their human impact.

CONCLUSION

This study explored the lived experiences of cancer patients undergoing nanomedicine-based drug delivery therapy, focusing on the emotional, psychological, and social dimensions of their

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treatment. The findings reveal that patients experience a dual emotional state, balancing hope for effective treatment with uncertainty and anxiety about the unknown long-term effects. These results address a significant gap in existing research by highlighting the psychosocial challenges that accompany this innovative therapy, offering deeper insights into patient-centered care beyond clinical outcomes. By using Interpretative Phenomenological Analysis (IPA), this study contributes a holistic understanding of patient experiences, emphasizing the need for psychological support and clear communication during treatment. Future research could expand on these findings by exploring long-term effects of nanomedicine therapies or investigating cross-cultural perspectives to further enhance patient care. The integration of both biomedical and emotional aspects in future studies will ensure a more comprehensive approach to cancer treatment. Future research could expand on these findings by exploring long-term effects of nanomedicine therapies, particularly in cancer survivors, to understand the lasting psychological and social impacts. Additionally, investigating cross-cultural perspectives on nanomedicine therapy would provide valuable insights into how cultural beliefs influence treatment perceptions and patient responses. The integration of both biomedical and emotional aspects in future studies, such as incorporating patient-reported outcomes (PROs) alongside qualitative interviews, will ensure a more comprehensive approach to cancer treatment.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this article.

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