Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5, 866-883
2025
Publisher: Learning Gate
DOI: 10.55214/25768484.v9i5.7037

Recent research trends in quantum therapy: A scoping review

Euna Si[1], Eun-Nyeo Choi[1], Jeongseon Kim[1], Sumi Cho[1], Youngsil Sung[1], Hyeran Cheong[1], Seok-Hae Seo[1], Chanju Jeon[1], Wondeok Lee[1*]
[1]The Quantum Medicine Research Institute of Gangdong University, South Korea; eunasi@gangdong.ac.kr (E.S.) enchoi01@gangdong.ac.kr (E.N.C.) cabbyjs@gangdong.ac.kr (J.K.) smcho@gangdong.ac.kr (S.C.) ysung@gangdong.ac.kr (Y.S.) hyeran@gangdong.ac.kr (H.C.) president@gangdong.ac.kr (S.H.S.) 1114@gangdong.ac.kr (C.J.) ptdeok@gangdong.ac.kr (W.L.)

Abstract: This study aims to identify current research trends in quantum therapy across non-technical scientific domains, with a focus on providing future research directions. Utilizing Arksey and O'Malley's five-stage scoping review framework, a systematic search was conducted in PubMed, Medline, and CINAHL for peer-reviewed studies published between 2020 and 2024. A total of 21 studies met the inclusion criteria. The analysis revealed a steady increase in quantum therapy research, predominantly in the form of review or descriptive studies. These were primarily concentrated in the fields of biology, chemistry, alternative and complementary medicine, and pharmacology, with only one study involving human participants. Findings indicate that the concept of quantum therapy remains inconsistently defined, and empirical clinical validation is significantly lacking. The study highlights the need for a unified theoretical framework, standardized methodologies, and interdisciplinary collaboration to enhance scientific rigor and applicability in clinical contexts. This review contributes by offering a foundational overview of quantum therapy research and emphasizes the importance of developing operational definitions and conducting human-centered clinical trials to realize the potential of quantum-based treatments in modern healthcare.

Keywords: *Complementary therapies, Medicine, Therapy, Quantum dots, Quantum theory.*

1. Introduction

Despite decades of continuous advances in modern medicine, many diseases remain untreatable. For example, neurodegenerative disorders, cancer, and chronic pain are complex, multifactorial diseases that are difficult to treat using conventional treatment methods [1]. Consequently, there is growing interest in integrative, holistic medicine that aims to treat the root cause of diseases [2].

Quantum medicine, inspired by quantum mechanics, is emerging as an intriguing alternative approach with the potential to revolutionize healthcare by providing new means for diagnosing and treating diseases at the quantum level. The principles of quantum mechanics, such as quantum coherence, entanglement, nonlocality, and interference, provide new methods for solving problems [3]. The application of these principles in medicine creates a novel paradigm that provides new perspectives for understanding biological systems [4].

For example, quantum sensors are individual systems for determining physical quantities that can interact irrespective of distance using quantum coherence, entanglement, and interference [5]. This enables more rapid measurements of the body, real-time mapping of neuronal activity, and sample imaging [6] which could introduce new possibilities for early disease detection and noninvasive diagnosis and treatment. The techniques of quantum dots and nanoparticles are becoming established as important elements of quantum medicine. Nanomaterials are used for precise drug delivery and imaging to optimize treatment for patients by reducing adverse effects [7]. Quantum dots have shown

History: Received: 18 February 2025; Revised: 25 April 2025; Accepted: 28 April 2025; Published: 10 May 2025
* Correspondence: ptdeok@gangdong.ac.kr

promising results, particularly in cancer treatment, where they enable targeted diagnosis of cancer cells and real-time monitoring of the state of cancer treatment, resulting in more precise treatment [8]. Furthermore, quantum computing technology is useful for simulating complex biological processes, helping to understand disease mechanisms, and providing new insights for drug discovery [9].

Quantum medicine differs from conventional modern medicine in that it provides a multidimensional perspective that involves various elements, including not only physical structures but also quantum wave fields and mind energy [10]. Quantum theory has been applied to explain the transmission of messages and neural networks. The mind operates via quantum energy, and positive and negative emotions affect physical health because of interactions between this energy and the body's quantum wave field [11]. These theories are based on the quantum theory proposed by David Bohm and emphasize the close connectivity between the mind and body [12]. Niels Bohr proposed that particles and waves are two complementary aspects of reality, providing a basis for understanding how quantum mechanics can be applied to biological processes [13]. Schrödinger argued that quantum phenomena can also play important roles in biological systems and claimed that biological order is derived from quantum mechanical stability [14]. These concepts stimulated debate on how quantum phenomena affect biological systems and play an important role in related studies providing evidence for quantum therapy. Recent studies have explored how quantum phenomena can be involved in the intracellular delivery of energy or the effects of radiation on the body [15]. Based on these theories, quantum medicine not only helps to advance existing diagnosis and treatment but also shows great potential to complement conventional medical approaches with diverse treatment methods, such as frequency therapy, nature therapy, mind therapy, homeopathy, hypnosis, and music therapy.

Nonetheless, many challenges remain regarding the practical application of quantum medicine treatment methods. Although theoretical studies have made major progress, in-depth education for experts and expensive infrastructure are required, and it remains necessary to understand and investigate the impact and significance on patient treatment in terms of the protection of personal information, consent, and equality. These tasks require considerable time and resources [16].

Although quantum therapy is still in its early stages, it could become an important turning point for medicine in the future. Quantum-based diagnostic tools and treatment methods are likely to develop rapidly in the next 10 years, which is expected to open a new chapter in medicine. However, alongside these technical advances, interdisciplinary cooperation is essential to address regulatory and ethical issues.

In this analysis of trends, we examined the changes in the level and quantity of quantum therapy-related research over the last 5 years, as well as research topics and methods, with the aim of providing a comprehensive summary of the latest trends in quantum therapy. We also ascertained the current status and limitations of quantum therapy in modern medicine.

Furthermore, in this study, we seek to fill a critical gap in the existing literature by providing a comprehensive overview of recent trends in quantum therapy research, identifying key challenges and limitations such as the lack of standardized definitions, limited clinical evidence, and ethical considerations, and formulating actionable recommendations for future research, including the need for interdisciplinary collaboration, the development of standardized protocols, and the establishment of ethical guidelines for quantum medicine research. We expect that this review will significantly contribute to the advancement of quantum medicine and its potential to revolutionize healthcare in the years to come.

2. Methods

2.1. Study Design

We conducted a scoping review of quantum therapy-related domestic and international research published in academic journals. The study followed the five-stage scoping review framework of Arksey and O'Malley: identifying the research question, identifying relevant studies, study selection, charting the data, and collecting, summarizing, and reporting the results [17]. Stages 1–4 are described in the

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

Methods section and stage 5 in the Results section.

2.2. Data Collection

2.2.1. Identifying Research Questions

The main research question for this study was established through discussions among the investigators, with reference to previous studies [18]. Since we sought to integrate practical evidence for treatments using quantum-based methods, we focused on identifying the subject areas of relevant studies and describe the main research questions as follows:

Q1. Changes in study performance

How have quantum medicine-related studies been conducted over the last 5 years (2020–2024)

Q2. Characteristics of the study participants

What were the research topics?

What research methods were used?

What academic fields have the studies been in?

What topics and subjects were covered in each field?

2.2.2. Relevant Studies

We searched the PubMed, Medline, and Cumulative Index to Nursing and Allied Health Literature (CINAHL) databases for studies published in English in peer-reviewed journals between January 2019 and May 2024. The initial search date was May 1, and the update search date was May 30, 2024. The search terms were selected using the population–concept–context framework (Table 1).

Table 1.
Search queries for the scoping review of quantum therapy.

PCC components	Organization	Search terms
Population	Human/non-human	[Not included]
Concept	Quantum-related research field	Quantum dots, quantum theory
Context	Quantum-related therapy	Medicine, therapy complementary therapies

Note: PCC: Population–concept–context framework.

The main search terms were "quantum dots," "quantum theory," "medicine," "therapy," and "complementary therapies." The search equations used medical subject headings, CINAHL headings, text words, and MeSH terms according to the characteristics of each database, as well as the Boolean operators "and/or" and truncation to improve the sensitivity and specificity.

2.2.3. Study Selection

A total of 292 studies were retrieved, including 176 from PubMed, 98 from Medline, and 18 from CINAHL (Fig. 1). We excluded 24 duplicate studies and a further seven studies that could not be accessed because they could not be downloaded or read from the search engine (Fig. 1). The titles and abstracts of the remaining 247 studies were reviewed by eight investigators, resulting in the exclusion of 89 studies with research objectives, subjects, or content that did not fit the eligibility criteria (Table 1). Finally, after reviewing the full texts of the remaining 158 studies and holding a research meeting to reach an agreement, 137 studies were excluded, leaving 21 studies for analysis (Fig. 1). The inclusion criteria were as follows: studies involving "quantum dots" and "therapy" or "medicine" published in indexed journals. The exclusion criteria were studies published in languages other than English and those published before 2019 Book (hardcover).

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

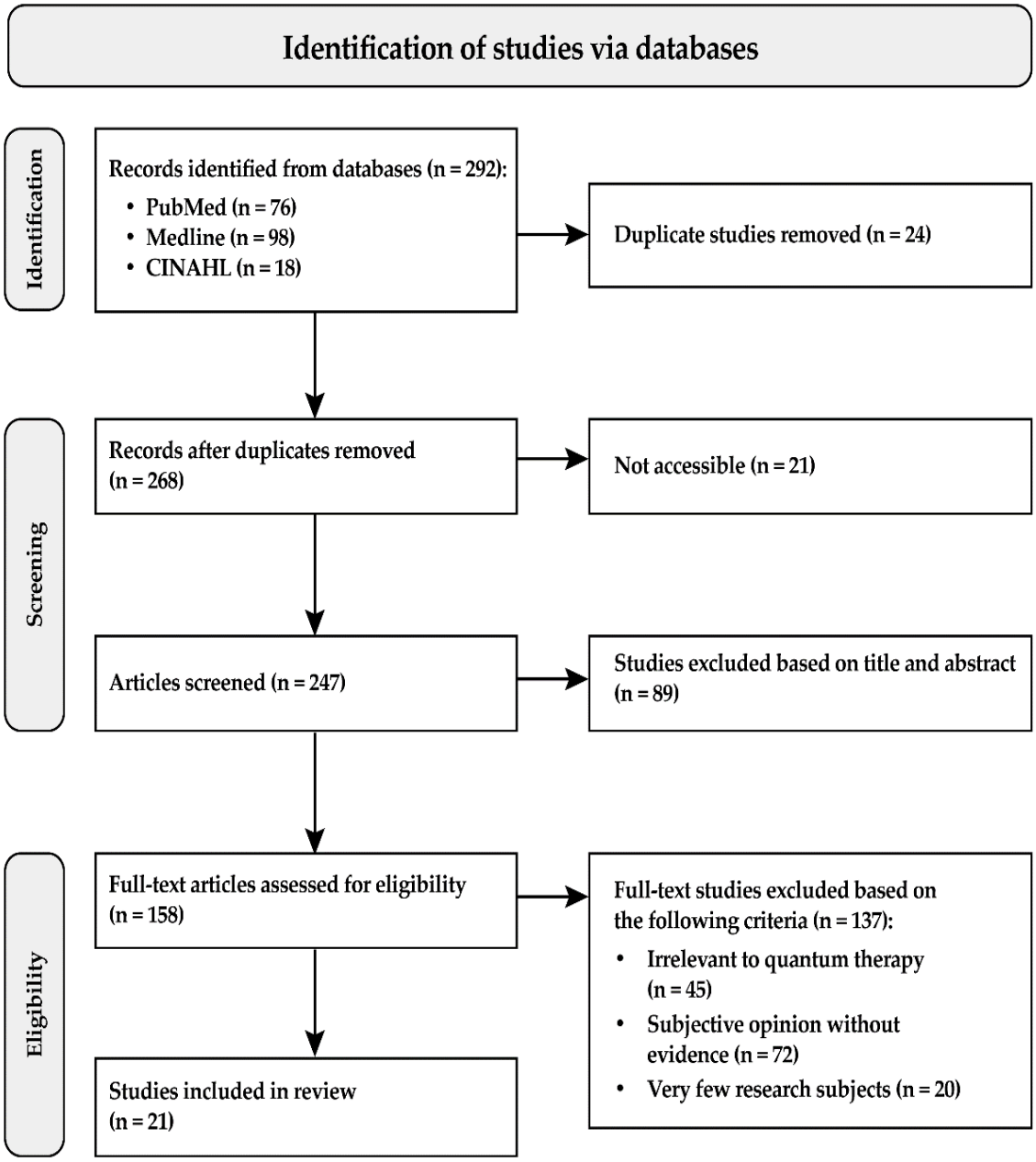

Figure 1.
PRISMA diagram of the study selection process.

2.3. Data Analysis

2.3.1. Development of an Analytical Framework

Data from eligible studies were extracted using the following analytical framework:

Study design: clinical trial, meta-analysis, randomized controlled trial, scoping review, review, or other;

Subjects (number): human or non-human;

Year of publication

Research field (type of journal): health-related (medicine, pharmacy, etc.) or health-unrelated

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

(biology, physics, biotechnology, etc.)

2.3.2. Charting Data

Data were charted using Microsoft Excel 2020 based on the above analytical framework. All data were coded, and Microsoft Excel 2020 was used for frequency analysis and descriptive statistics.

Data analysis was performed independently by three investigators, and the findings were cross-checked. Any studies with disagreement were thoroughly reviewed and discussed by the remaining five investigators.

3. Results

3.1. General Characteristics of the Selected Studies

Table 2 presents the general characteristics of the included studies. In terms of study design, all 21 studies were review articles. Study subjects were non-human in all but one study. Regarding the year of publication, the largest number of studies were published in 2020 (n = 4), 2022 (n = 5), and 2023 (n = 4), suggesting an increasing trend over the years. The most common research fields in which the studies were conducted were biology (n = 4), followed by medicine, alternative and complementary medicine, chemistry (n = 3), chemical physics (n = 2), pharmacology (n = 2), neurophysiology (n = 2), radiology (n = 1), and biochemistry (n = 1), suggesting growing interest in demonstrating quantum phenomena in organisms, as well as the importance of quantum technology in the fields of medicine.

Table 2.
General characteristics of the included studies (n = 21).

Characteristic	Categories	N (%)
Publication year	2019	2 (9.5%)
	2020	5 (23.8%)
	2021	2 (9.5%)
	2022	5 (23.8%)
	2023	4 (19.0%)
	2024	1 (4.7%)
Research field	Biology	4 (19.0%)
	Medicine	3 (14.2%)
	Alternative and complementary medicine	3 (14.2%)
	Chemistry	3 (14.2%)
	Chemical physics	2 (9.5%)
	Pharmacology	2 (9.5%)
	Neurophysiology	2 (9.5%)
	Radiology	1 (4.7%)
	Biochemistry	1 (4.7%)
Study design	Review	21 (100%)
Subjects	Human	1 (4.7%)
	Non-human	20 (95.2%)

3.2. Trends in Quantum Therapy Research According to Research Field

The main results of the studies are summarized in Table 3.

3.2.1. Biology

Quantum mechanical methods and machine learning models are being developed to enhance drug discovery and to explain complex biological processes in molecular biology and genetics.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

3.2.2. Medicine

Quantum technology shows promise for faster and more accurate diagnosis, as well as improved drug development and clinical trial success rates.

3.2.3. Alternative and complementary medicine

While interest in quantum methods for homeopathy is growing, results remain inconclusive, but quantum physics may offer insights into biological phenomena and consciousness.

3.2.4. Chemistry

New relativistic quantum chemistry methods can improve our understanding of light-induced treatment mechanisms and therapeutic molecule interactions.

3.2.5. Chemical Physics

Quantum plasmonic sensing is advancing to overcome the limitations of existing sensors and has potential applications in biochemistry, medicine, and pharmaceutics.

3.2.6. Pharmacology

A framework links quantum mechanics to human consciousness by exploring the roles of neuronal microtubules in quantum processes, thus addressing the limitations of conventional neuroscience.

3.2.7. Neurophysiology

Quantum technology has potential in healthcare for drug development, diagnostics, and data security, but it faces challenges in terms of implementation and ethical considerations.

3.2.8. Radiology

Integrating multiomics data and quantum computing in radiation oncology offers potential for personalized treatment, despite challenges in data analysis and interpretation.

3.2.9. Biochemical

Nanobiomaterials exhibit high biomedical potential for drug delivery, oncology, and tissue engineering, but their advancement is hindered by toxicity and regulatory constraints.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

Table 3.
Main results of each included study.

No.	Study design[a]	Subjects[b]	Type of research field (health or non-health-related)[c]	Publication journal	Research field	Key findings
1 Feng, et al. [19]	R	NonH	Non-HR	Progress in Biophysics and Molecular Biology	Biology	This paper highlights how quantum biology leverages quantum mechanics to explain complex biological processes, such as energy transfer and molecular dynamics, emphasizing the role of quantum phenomena in photosynthesis, enzyme activity, deoxyribonucleic acid (DNA) processes, and brain function, which classical mechanics cannot fully address.
2 Grunt and Heller [20]	R	NonH	Non-HR	Progress in Biophysics and Molecular Biology	Biology	This study emphasizes the need for a holistic understanding of carcinogenesis by integrating the roles of tissue architecture, genetics, epigenetics, and cell metabolism, highlighting their interplay and the critical influence of the microenvironment alongside genetic mutations in cancer progression.
3 Kuwata [21]	R	NonH	Non-HR	Progress in Molecular Biology and Translational Science	Biology	This study explored protein surgery as a precision technique for modifying protein structures to correct molecular defects, offering a targeted approach to drug design for neurodegenerative diseases, such as Alzheimer's and Parkinson's, by addressing specific malfunctioning pathways.
4 Manathunga, et al. [22]	R	NonH	Non-HR - nanoparticle hypothesis	Current Opinion in Structural Biology	Biology	This paper highlights recent advances in quantum mechanical methods for computer-aided drug design. It emphasizes the integration of hybrid quantum mechanical/molecular mechanical methods and machine learning into drug discovery to enhance accuracy while reducing computational costs. These developments allow for efficient modeling of specific drug binding sites while simplifying calculations for less relevant regions. The study also highlights the potential of quantum machine learning models to further accelerate and improve the precision of drug discovery processes.
5 Bisiani, et al. [16]	R	NonH	HR - medicine	Journal of Clinical Medicine	Medicine	This study highlights the growing role of quantum technology in medicine, emphasizing its ability to enhance diagnostics and treatments through advanced data processing, highly sensitive quantum sensors for non-invasive diagnostics, and personalized therapies based on detailed modeling of patient-specific biological systems.
6 Bonde, et al. [23]	R	NonH	HR - medicine	Methods in Molecular Biology	Medicine	This study illustrates how quantum computing accelerates drug development by enabling precise molecular simulations, optimizing drug candidate identification, streamlining compound library screening, and ultimately reducing costs while increasing the success rate of new drug approvals.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

7 Calvillo, et al. [24]	R	NonH	HR	Quantum Reports	Medicine	Recent advancements in quantum biology offer a promising framework for biomedical research, addressing complex immune, cardiovascular, and neural pathologies through mechanisms such as electromagnetic fields, mitochondrial proton pumping, T-cell receptor (TCR)-degeneracy, and quantum properties of ions and protons, potentially paving the way for novel therapeutic strategies and interdisciplinary exploration.
8 Tournier, et al. [25]	SR	NonH	Non-HR	Journal of Alternative and Complementary Medicine	Alternative and complementary medicine	This study provides a systematic review and bibliometric analysis of physicochemical investigations related to homeopathic preparations. The review highlights that although there is growing interest in this field, the results are highly heterogeneous and often inconclusive, with a wide variety of methodologies and findings. This study identifies significant challenges in standardizing experimental approaches and calls for more rigorous and reproducible research. The findings also suggest that advances in technology and methodology may lead to more reliable insights into the nature of homeopathic preparations.
9 Tuszynski [26]	R	NonH	HR- atomic level analysis	Journal of Alternative and Complementary Medicine	Alternative and complementary medicine	This paper explores the application of quantum physics to biology, particularly in explaining biological phenomena such as photosynthesis and bird navigation. This suggests that quantum effects such as superposition and entanglement may play crucial roles in biological processes, even in warm, noisy environments. The paper also delves into the idea that quantum physics could offer insights into consciousness, highlighting the Orch OR theory, which suggests that quantum computations in microtubules might be key to conscious thought.
10 Wagdy [27]	R	NonH	HR	Journal of Quantum Science of Consciousness	Alternative and complementary med icine	Most chronic diseases are psychosomatic, resulting from chronic stress induced by prolonged negative mental states, which dysregulate physiological functions and distort energy flow. Most of the diseases faced today are due to the negative mental states of stress, creating a disbalance within the mind and energy systems, affecting the brain and, therefore, the body, and ultimately, affecting the very fabric of the reality of our existence. We face serious health concerns that cannot be understood in isolation because they are systemically rooted in the interconnectedness and interdependency of holism. This paper reviews the literature on the healing of chronic diseases using integrative medicine, a medicinal system that includes the mainstream allopathic system with alternative systems, generally referred to as holistic (or integrative) medicines.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

11 Hedegård and Creutzberg [28]	R	NonH	NonHR	Dalton Transactions	Chemistry	This study introduces advanced relativistic quantum chemical methods that enhance the accuracy of modeling light-induced therapeutics, particularly for heavy-element drugs, enabling deeper insights into molecular interactions and optimizing light-activated treatments.
12 Pecina, et al. [29]	SR	NonH	HR-medicine	Chempluschem	Chemistry	The key findings of this study highlight the development and success of the semiempirical quantum mechanical-based scoring function (SQM/COSMO SF), a quantum-mechanical tool for structure-based drug design. This method improves the accuracy of protein-ligand interaction modeling by combining semiempirical quantum mechanical (SQM) methods with implicit solvent models, thereby making it faster and more reliable than standard scoring methods. The proposed approach has demonstrated superior performance in virtual screening and native pose identification, outperforming traditional methods in various protein-ligand binding studies. The authors propose SQM/COSMO as a practical and efficient tool for drug design.
13 Bowman, et al. [30]	R	NonH	NonHR	Journal of Chemical Theory and Computation, American Chemical Society	Chemistry	This paper highlights how Δ-machine learning (Δ-ML) enhances the accuracy of potential energy surfaces and force fields, bridging DFT calculations with high-level quantum methods, offering scalable solutions for complex and large molecules, and improving molecular interaction accuracy in simulations.
14 Lee, et al. [31]	R	NonH	Non-HR	Chemical Reviews	Chemical physics	This paper highlights advancements in quantum plasmonic sensing, which leverages quantum resources to surpass the shot-noise limit of conventional plasmonic sensors, enabling breakthroughs in chemical and biological sensing with significant implications for biochemistry, medicine, and pharmaceuticals.
15 Loring [32]	R	NonH	Non-HR	Annual Review of Physical Chemistry	Chemical physics	The key findings of this study emphasize the utility of semiclassical methods for calculating multidimensional optical spectra, particularly for molecular systems. This study demonstrates that classical trajectory-based approaches can be a practical alternative to computationally demanding quantum dynamics, especially for complex systems such as those in the condensed phase. By applying semiclassical techniques, the study successfully computed nonlinear vibrational and electronic spectra, providing a way to interpret molecular interactions that are difficult to observe using traditional methods. This approach bridges quantum and classical mechanics and is thus an efficient method for modeling ultrafast spectroscopy.
16 Li, et al. [33]	R	H	Non-HR	Annals of Translational Medicine	Pharmacology	This paper explores the orchestrated objective reduction (Orch OR) theory and proposes that quantum mechanics, through phenomena such as coherence and superposition within

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

						microtubules in brain cells, bridges gaps in traditional neuroscience, offering a quantum framework for understanding consciousness beyond classical models.
17 Lodola, et al. [34]	R	NonH	Non-HR	Methods in Molecular Biology	Pharmacology	This study investigates the design and structure–activity relationship analysis of covalent inhibitors using hybrid quantum mechanics/molecular mechanics (QM/MM) simulations. This study demonstrates how QM/MM simulations can be effectively applied to predict and optimize covalent bonding interactions between inhibitors and target proteins. The results highlight the importance of accurately modeling the reactivity and binding modes of inhibitors, thereby enabling a more precise design of covalent inhibitors. The findings underline the significant role of QM/MM methods in enhancing the drug design process, particularly for developing covalent drugs.
18 Shams, et al. [4]	R	NonH	Non-HR	Cureus	Neurophysiology	The key findings of this study explore the transformative potential of quantum technologies in healthcare, particularly in areas such as drug discovery, diagnostic imaging, and data security. Quantum computing has been shown to accelerate drug discovery and genomic analysis, whereas quantum sensors offer unprecedented sensitivity for biomarker detection. In addition, quantum communication enhances the security of medical records and telemedicine platforms. Despite these advances, this paper also highlights the challenges of integrating quantum technologies into healthcare, such as scalability, cost, and ethical considerations related to data privacy and accessibility.
19 Tierney, et al. [35]	R	NonH	HR	Neuroimage	Neurophysiology	This paper highlights the advantages of optically pumped magnetometers (OPMs) as wearable and flexible alternatives to traditional cryogenic superconducting magnetoencephalography (MEG) systems. OPMs do not require cryogenic cooling, allowing for their placement on various parts of the body, thereby enhancing flexibility and convenience in neuroimaging. The paper also provides a detailed explanation of the physical principles behind OPMs, including their reliance on magnetic resonance and the critical trade-offs between bandwidth, sensor size, and sensitivity. The analysis focuses on the performance limits of OPMs in multichannel systems, particularly on gain changes due to crosstalk.
20 Niraula, et al. [36]	R	NonH	Non-HR	British Journal of Radiology	Radiology	The key findings of this study focused on advancements in data-driven technologies and the integration of multiomics data in radiation oncology to improve outcome prediction models (OPMs). These new approaches enable personalized treatment and adaptive radiotherapy, surpassing traditional methods by

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

						incorporating genomic, proteomics, and radiomics data. However, challenges such as limited sample sizes, data noise, and model interpretability remain. Emerging technologies such as federated learning, quantum computing, and human-in-the-loop systems show promise in overcoming these challenges and advancing precision medicine in radiation oncology.
21 Sinha, et al. [37]	R	NonH	Non-HR	Materials Today Biology	Biochemistry	This paper highlights the revolutionary applications of nanobiomaterials in various fields, particularly biomedicine. The unique properties of these materials, such as their biocompatibility and nanoscale functionality, make them promising candidates for drug delivery, cancer therapy, tissue engineering, and biosensors. This study emphasizes the potential of nanobiomaterials in the development of advanced medical devices, improved drug delivery systems, and enhanced cancer treatment efficacy. In addition, challenges such as toxicity, regulatory hurdles, and future perspectives for the commercial use of these materials are discussed.

Note: a Type of study design: CT: Clinical trial, MA: Meta-analysis, RCT: Randomized controlled trial, SR: Scoping review, R: Review, O: Other.
b Subjects: H: Human, NonH: Non-human.
c Research field type: HR: health-related (medicine, pharmacy, etc.), NonHR: Health-unrelated (biology, physics, biotechnology, etc.).

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

4. Discussion

4.1. Main Findings

4.1.1. Biology

These studies emphasized the development of quantum mechanical methods in computer-assisted drug design and the potential of quantum machine learning models to accelerate and improve the precision of drug discovery processes [19]. Quantum biology explains complex biological processes by applying the principles of quantum mechanics. It has been suggested that quantum models are becoming increasingly important for explaining phenomena in the fields of molecular biology and genetics that cannot be explained using classical mechanics [20]. The study investigated protein surgery as a precise method for correcting molecular defects, enabling targeted drug design for neurodegenerative diseases such as Alzheimer's and Parkinson's [21]. This paper highlights the integration of quantum methods and machine learning in drug design to enhance accuracy, lower costs, and increase the speed of discovery [22].

4.1.2. Medicine

A growing number of studies have focused on the importance of quantum technology in diagnosis and treatment. In particular, emphasis is placed on the potential for more rapid and accurate diagnosis using quantum computing and quantum sensors, as well as the potential to improve the success rate of new drug approvals and reduce costs by integrating quantum computing into drug development for clinical trials [23]. This study highlights quantum technology's potential to enhance diagnostics and personalized therapies through advanced data processing, quantum sensors, and biological modeling [16]. Quantum computing accelerates cost-effective drug development with higher success rates [24].

4.1.3. Alternative and Complementary Medicine

A systematic review of physicochemical studies on homeopathic formulations, including quantum methods, demonstrated that interest in this field is growing, but the results are still very heterogeneous, making it difficult to draw firm conclusions. Technical and methodological advances could provide more reliable insights into homeopathy [25]. Another study argued that quantum physics, particularly quantum effects such as superposition and entanglement, could play an important role in explaining biological phenomena and provide insights into human consciousness [26]. Furthermore, the future potential for the treatment of chronic diseases was examined using integrative medicine, a medical system that includes complementary systems, commonly referred to as holistic medicine, and major homeopathy systems [27].

4.1.4. Chemistry

This paper presents SQM/COSMO as a quantum-mechanical scoring function that enhances accuracy and efficiency in protein-ligand modeling, outperforming traditional methods in drug design [28]. Relativistic quantum chemistry methods enhance the accuracy of predicting the interactions between molecules and light for light-induced treatments [29, 30].

4.1.5. Chemical physics

This study highlights quantum plasmonic sensing's potential to enhance sensor performance and drive breakthroughs in biochemistry, medicine, and pharmaceutics [31, 32].

4.1.6. Pharmacology

Focusing on the relationship between quantum mechanics and human consciousness, which is a limitation of conventional neuroscience, a framework was suggested to link conscious experience with quantum theory by exploring the important roles of neuronal microtubules in quantum processes [33, 34].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

4.1.7. Neurophysiology

Studies explore that quantum technology has transformative potential in healthcare, enhancing drug development, diagnostic imaging, and data security while addressing challenges such as cost, accessibility, and data privacy [4, 35].

4.1.8. Radiology

Data-driven techniques and multiomics integration in radiation oncology enable customized treatments though challenges such as data noise and model interpretability persist. Emerging technologies such as quantum computing and federated learning can address these challenges and improve precision medicine [36].

4.1.9. Biochemical

Nanobiomaterials hold significant potential in biomedicine for applications like drug delivery, cancer therapy, and tissue engineering, but their development faces challenges such as toxicity and regulatory hurdles [37].

In this study, we used the scoping review method to evaluate the characteristics and main outcomes of studies on quantum therapy with the purpose of identifying the current trends and limitations of research on this topic and presenting directions for future research. Our analysis showed that the number of studies on quantum therapy has steadily increased over the years. The greatest interest was observed in the field of biology, followed by alternative and complementary medicine, chemistry, chemical physics, medicine, and pharmacology, with one study in each field of radiology, neurophysiology, biochemistry, and neuroscience. These findings suggest a growing interest in quantum techniques for diagnosis and treatment. However, the studies conducted to date are mostly limited to experimental or theoretical levels, and significant treatment effects in humans have not been demonstrated. All analyzed studies were review articles, and only one study involved human subjects. This confirmed that there is insufficient academic evidence to demonstrate the clinical effects of quantum therapy. Moreover, most studies did not clearly define the concepts of quantum therapy, which could have confounded the evaluation of the effects.

4.2. Current Trends in Quantum Therapy Research

In the field of biology, previous studies have demonstrated quantum phenomena in organisms. Feng, et al. [19] reported that quantum models are increasingly important for explaining phenomena in molecular biology and genetics that cannot be explained using classical mechanics. Tuszynski [26] also explored whether quantum physics could be applied to explain biological phenomena such as photosynthesis and bird navigation.

In the field of alternative and complementary medicine, several studies have reviewed the use of quantum therapy from a psychiatric perspective. In particular, quantum effects such as quantum superposition and entanglement were claimed to play important roles in biological processes and could provide insights into human consciousness, highlighting the Orch OR theory, which argues that quantum computations in microtubules could be a core component of consciousness. Wagdy [27] reviewed studies on the treatment of chronic diseases using integrative medicine, a medical system that includes alternative systems commonly referred to as holistic medicine, and major homeopathic systems. In particular, in both mental and physical well-being, most modern diseases are considered to be aggravated by the negative mental state of stress and can be induced by a physiological imbalance in biochemical functions and energy flow. Thus, from the perspective of holistic or integrative medicine, quantum physics is involved in the relationship between energy and material, indicating that energy-related quantum medicine is essential for health and healing, and optimal healing requires these ideas to be unified in a single paradigm.

In the field of chemistry, Hedegård and Creutzberg [28] introduced new relativistic quantum chemistry methods to better understand the mechanisms of light-induced treatment techniques and

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

showed that the integration of relativistic effects into quantum chemical models could greatly improve accuracy when predicting the nature of interactions between therapeutic molecules and light. In the field of chemical physics, Lee, et al. [31] observed that existing plasmonic sensors ran into the known classical limitation of shot noise due to quantum fluctuations in light and provided an overall framework of quantum plasmonic sensing, which uses quantum resources to improve sensory performance to overcome this limitation. The authors also discussed the impact of these developments in the fields of biochemistry, medicine, and pharmaceutics.

In the field of pharmacology, Li, et al. [33] focused on the relationship between quantum mechanics and human consciousness and explored this relationship using the Orch OR theory. They noted that conventional neuroscience is limited in its ability to fully explain consciousness and proposed that the unique properties of quantum mechanics, such as quantum coherence and superposition, could overcome these limitations. In addition, they explored in depth the important role that neuronal microtubules play in quantum processes and suggested a framework connecting quantum theory with conscious experience. They argued that the integration of quantum mechanics would provide new perspectives on consciousness, beyond those of classical models.

In neurophysiology, Shams, et al. [4] explored the groundbreaking potential of quantum technology in healthcare and found that this technology could play particularly important roles in new drug development, diagnostic imaging, and data security, confirming the applicability of quantum technologies in the field of healthcare.

After summarizing the results of the analyzed studies, we identified commonalities. There is active research in various fields using quantum theory, and above all, this is being suggested as a solution to problems perceived as limitations in research to date or when using current methodologies. The findings also suggest directions for future research in each field. In terms of the implications of quantum-based treatments for clinical settings, which was one of our main research questions, perhaps the most important view is the need for quantum medicine from the perspective of integrative medicine, as emphasized by Wagdy [27].

Quantum medicine is based on initial knowledge of quantum physics. Based on the principles and techniques of quantum physics, all matter in the universe has a dual structure consisting of particles and waves, and everything in the universe is mutually connected by the principle of nonlocality [38]. As mental processes create matter, quantum physics leads to quantum biology, which in turn leads to quantum medicine. To overcome the limitations of modern medicine, there have been approaches to treatment based on mental, emotional, spiritual, and social health [39]. The quantum mind or quantum consciousness hypothesis suggests that quantum mechanical phenomena play important roles in brain function and form the basis for explaining consciousness, which has many implications for future quantum mechanics treatment [40].

4.3. Current Limitations of Quantum Therapy Research

A major limitation of current quantum-based treatment research is the extremely limited research scope. Our analysis revealed a lack of diversity in study design and subjects. The human research was particularly limited, with only one study involving human subjects. The majority of studies focused on theoretical approaches, and there was often a lack of experimental verification. As a result, the reliability of the actual clinical effects of quantum therapy is low, and it is difficult to evaluate its applicability in humans. In addition, previous studies did not provide sufficient data to demonstrate clinical effects. Although some studies suggested positive results, most depended on small-scale experiments, leading to inconsistent results or did not reach statistical significance. As a result, quantum therapy has not yet been thoroughly established from a scientific or clinical perspective. For quantum therapy to be used in real clinical settings, conducting research that can verify its clinical effects in humans is essential.

Bisiani, et al. [16] provided a useful perspective on the possible reasons for the uncertainty regarding the clinical efficacy of existing quantum therapy. They reported that one of the biggest

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

concerns, considering the characteristics of the healthcare and clinical environment, was the potential cost of developing and implementing a quantum-based approach. The advances required to achieve quantum-based medical technology will not be immediately usable, and the application of quantum physics to medicine will require expensive infrastructure and education for healthcare experts. The transition to quantum physics-based medical technology is expected to require a heavy investment of time and money because, while it is a new concept, too many practical tasks need to be completed. Nevertheless, doctors continue to learn various techniques, styles, and methods to diagnose and treat patients, and if they were to integrate a strong understanding of quantum physics, this could help fill the gaps between various fields and develop strong interconnections between diverse scientific disciplines [16].

Another limitation of current research on quantum-based treatment is the lack of a theoretical definition of quantum therapy. Furthermore, in the analyzed studies, we identified efforts in each field to investigate and apply quantum phenomena to overcome the limitations of existing technology and theory and to demonstrate the potential for quantum theory to be introduced into new technologies. However, in most disciplines, there is still a shortage of studies that investigate operational definitions related to quantum theory and empirically test its efficacy. The studies were able to highlight the possibilities without empirical validation. To this end, both theoretical and operational definitions are required. Establishment of concepts through an objective, unified theoretical system for quantum therapy should be prioritized to ensure the reliability of results.

Medical understanding of quantum mechanisms of action and specific quantum treatments has lagged because the role of quantum physics in biology is neither well understood nor taught in medical schools [41]. Considering that science is ultimately a problem of measurement [42] the difficulty associated with quantum mechanics measurements is sufficient to question the scientific value of quantum approaches to quantum therapy. However, recently, quantum measurements of entanglement, which had previously been perceived only as a philosophical problem or a problem in the interpretation of quantum mechanics, have actually been achieved [43]. As such, in future studies, it will be essential to clarify the concepts of quantum-based treatment and to design studies based on these concepts. Specifically, conceptual analysis should be performed first to elucidate the meaning of quantum therapy, and this should be used to establish theoretical evidence and design specific, reproducible experiments. In addition, since quantum fields react to what and who we are based only on our thoughts (electrical) and emotions (magnetic), and move according to our beliefs [28] a holistic healing approach is clearly needed.

4.4. Directions for Future Research

Based on the above, it is crucial to establish theoretical definitions for quantum therapy and conduct clinical studies based on these definitions. Moreover, the actual clinical effects of quantum therapy will need to be assessed in diverse subjects and by collecting more clinical data. We propose the following specific research directions:

Extension of clinical research. Large-scale clinical trials with diverse patient groups are needed. The small-scale studies performed to date are insufficient to establish reliability. To augment theoretical evidence, it is important to develop a clear theoretical foundation for quantum therapy. To this end, the intersections between quantum physics and bio medicine should be investigated in depth, and a theoretical model should be constructed. The actual effects of quantum therapy could be more clearly investigated through an interdisciplinary approach, where researchers from various fields, including physics, medicine, and biology, collaborate to assess the potential effects of quantum therapy from multiple perspectives.

5. Conclusions

In this scoping review, we confirmed that research on quantum therapy has been gradually expanding since 2020, and that interest in the subject has been increasing. In our analysis, most studies

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037

were not technical, but rather technical descriptive or review studies focusing on the field of medicine. However, despite the promising trends, the lack of strict experimental studies or standardization of methodology remains a challenge for the transition of quantum therapy into mainstream medicine. Future studies should prioritize robust experimental designs, standardized protocols, and interdisciplinary collaboration in order to reduce the gap between theoretical developments and practical applications. If this gap can be reduced, quantum therapy will have the potential to greatly contribute to pioneering medical solutions.

Funding:
This research was supported by Gangdong University (Grant No. 2024GDBIO09COL001). The funding covered literature search, database access, data management, and professional English editing services.

Transparency:
The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

References
[1] A. Talebi Bezmin Abadi, A. A. Rizvanov, T. Haertlé, and N. L. Blatt, "World health organization report: Current crisis of antibiotic resistance," *BioNanoScience*, vol. 9, no. 4, pp. 778-788, 2019. https://doi.org/10.1007/s12668-019-00658-4

[2] R. Mamtani and A. Cimino, "A primer of complementary and alternative medicine and its relevance in the treatment of mental health problems," *Psychiatric Quarterly*, vol. 73, pp. 367-381, 2002. https://doi.org/10.1023/a:1020472218839

[3] F. F. Flöther, "The state of quantum computing applications in health and medicine," *Research Directions: Quantum Technologies*, vol. 1, pp. 1–21, 2023. https://doi.org/10.1017/qut.2023.4

[4] M. Shams *et al.*, "The quantum-medical nexus: Understanding the impact of quantum technologies on healthcare," *Cureus*, vol. 15, no. 10, p. e48077, 2023. https://doi.org/10.7759/cureus.48077

[5] C. L. Degen, F. Reinhard, and P. Cappellaro, "Quantum sensing," *Reviews of Modern Physics*, vol. 89, no. 3, p. 035002, 2017. https://doi.org/10.1103/RevModPhys.89.035002

[6] N. Aslam *et al.*, "Quantum sensors for biomedical applications," *Nature Reviews Physics*, vol. 5, no. 3, pp. 157-169, 2023. https://doi.org/10.1038/s42254-023-00558-3

[7] H. Zhang, D. Yee, and C. Wang, "Quantum dots for cancer diagnosis and therapy: Biological and clinical perspectives," *Nanomedicine*, vol. 3, no. 1, pp. 83-91, 2008. https://doi.org/10.2217/17435889.3.1.83

[8] J. Ahmad, A. Garg, G. Mustafa, M. Z. Ahmad, M. Aslam, and A. Mishra, "Hybrid quantum dot as promising tools for theranostic application in cancer," *Electronics*, vol. 12, no. 4, p. 972, 2023. https://doi.org/10.3390/electronics12040972

[9] S. K. Kandula, N. Katam, P. R. Kangari, A. Hijmal, R. Gurrala, and M. Mahmoud, "Quantum computing potentials for drug discovery," presented at the International Conference on Computational Science and Computational Intelligence, 2023.

[10] B. J. Fertig, D. Chopra, and J. A. Tuszynski, "Towards quantum medicine," *Journal of Alternative and Complementary & Integrative Medicine*, vol. 8, p. 251, 2022. https://doi.org/10.24966/ACIM-7562/100251

[11] M. J. Gonzalez, E. Sutherland, and J. Olalde, "Quantum functional energy medicine: The next frontier of restorative medicine," *Journal of Restorative Medicine*, vol. 9, no. 1, pp. 1–7, 2020. https://doi.org/10.14200/jrm.2019.011

[12] W. Seager, "The philosophical and scientific metaphysics of David Bohm," *Entropy*, vol. 20, no. 7, p. 493, 2018. https://doi.org/10.3390/e20070493

[13] D. S. Starke, M. L. W. Basso, and J. Maziero, "An updated quantum complementarity principle," in *Proceedings of the Royal Society A*, 2024, vol. 480, doi: https://doi.org/10.1098/rspa.2024.0517.

[14] S. Kauffman, "Answering schrödinger's "What is life?"," *Entropy*, vol. 22, no. 8, p. 815, 2020. https://doi.org/10.3390/e22080815

[15] B. F. Matarèse, A. Rusin, C. Seymour, and C. Mothersill, "Quantum biology and the potential role of entanglement and tunneling in non-targeted effects of ionizing radiation: A review and proposed model," *International Journal of Molecular Sciences*, vol. 24, no. 22, p. 16464, 2023. https://doi.org/10.3390/ijms242216464

[16] J. Bisiani, A. Anugu, and S. Pentyala, "It's time to go quantum in medicine," *Journal of Clinical Medicine*, vol. 12, no. 13, p. 4506, 2023. https://doi.org/10.3390/jcm12134506

[17] H. Arksey and L. O'malley, "Scoping studies: towards a methodological framework," *International Journal of Social Research Methodology*, vol. 8, no. 1, pp. 19-32, 2005. https://doi.org/10.1080/1364557032000119616

[18] C. Mitton, N. Smith, S. Peacock, B. Evoy, and J. Abelson, "Public participation in health care priority setting: A scoping review," *Health Policy*, vol. 91, no. 3, pp. 219-228, 2009. https://doi.org/10.1016/j.healthpol.2009.01.005

[19] J. Feng, B. Song, and Y. Zhang, "Semantic parsing of the life process by quantum biology," *Progress in Biophysics and Molecular Biology*, vol. 175, pp. 79-89, 2022. https://doi.org/10.1016/j.pbiomolbio.2022.09.005

[20] T. W. Grunt and G. Heller, "A critical appraisal of the relative contribution of tissue architecture, genetics, epigenetics and cell metabolism to carcinogenesis," *Progress in Biophysics and Molecular Biology*, vol. 182, pp. 26-33, 2023. https://doi.org/10.1016/j.pbiomolbio.2023.05.004

[21] K. Kuwata, "The Principles of protein surgery and its application to the logical drug design for the treatment of neurodegenerative diseases," *Progress in Molecular Biology and Translational Science*, vol. 175, pp. 359-374, 2020. https://doi.org/10.1016/bs.pmbts.2020.08.004

[22] M. Manathunga, A. W. Götz, and K. M. Merz Jr, "Computer-aided drug design, quantum-mechanical methods for biological problems," *Current Opinion in Structural Biology*, vol. 75, p. 102417, 2022. https://doi.org/10.1016/j.sbi.2022.102417

[23] B. Bonde, P. Patil, and B. Choubey, "The future of drug development with quantum computing," *High Performance Computing for Drug Discovery and Biomedicine*, vol. 2716, pp. 153-179, 2023. https://doi.org/10.1007/978-1-0716-3449-3_7

[24] L. Calvillo *et al.*, "Quantum biology research meets pathophysiology and therapeutic mechanisms: A biomedical perspective," *Quantum Reports*, vol. 4, no. 2, pp. 148-172, 2022. https://doi.org/10.3390/quantum4020011

[25] A. Tournier, S. Würtenberger, S. D. Klein, and S. Baumgartner, "Physicochemical investigations of homeopathic preparations: A systematic review and bibliometric analysis—part 3," *Journal of Alternative and Complementary Medicine*, vol. 27, no. 1, pp. 45-57, 2021. https://doi.org/10.1089/acm.2020.0243

[26] J. A. Tuszynski, "From quantum chemistry to quantum biology: A path toward consciousness," *Journal of Integrative Neuroscience*, vol. 19, no. 4, pp. 687-700, 2020. https://doi.org/10.31083/j.jin.2020.04.393

[27] E. Wagdy, "Integrative Medicine for healing chronic diseases: A review," *Journal of Quantum Science and Consciousness*, vol. 2, pp. 72–79, 2024. https://doi.org/10.69573/jqsc.2024.2.1.31.72-79

[28] E. D. Hedegård and J. Creutzberg, "New relativistic quantum chemical methods for understanding light-induced therapeutics," *Dalton Transactions*, vol. 51, no. 42, pp. 16055-16064, 2022. https://doi.org/10.1039/d2dt02233h

[29] A. Pecina *et al.*, "SQM/COSMO scoring function: Reliable quantum-mechanical tool for sampling and ranking in structure-based drug design," *ChemPlusChem*, vol. 85, no. 11, pp. 2362-2371, 2020. https://doi.org/10.1002/cplu.202000120

[30] J. M. Bowman, C. Qu, R. Conte, A. Nandi, P. L. Houston, and Q. Yu, "Δ-machine learned potential energy surfaces and force fields," *Journal of Chemical Theory and Computation*, vol. 19, no. 1, pp. 1-17, 2022. https://doi.org/10.1021/acs.jctc.2c01034

[31] C. Lee, B. Lawrie, R. Pooser, K.-G. Lee, C. Rockstuhl, and M. Tame, "Quantum plasmonic sensors," *Chemical Reviews*, vol. 121, no. 8, pp. 4743-4804, 2021. https://doi.org/10.1021/acs.chemrev.0c01028

[32] R. F. Loring, "Calculating multidimensional optical spectra from classical trajectories," *Annual Review of Physical Chemistry*, vol. 73, no. 1, pp. 273-297, 2022. https://doi.org/10.1146/annurev-physchem-082620-021302

[33] T. Li, H. Tang, J. Zhu, and J. H. Zhang, "The finer scale of consciousness: Quantum theory," *Annals of Translational Medicine*, vol. 7, no. 20, p. 585, 2019. https://doi.org/10.21037/atm.2019.09.09

[34] A. Lodola, D. Callegari, L. Scalvini, S. Rivara, and M. Mor, "Design and SAR analysis of covalent inhibitors driven by hybrid QM/MM simulations," *Quantum Mechanics in Drug Discovery*, pp. 307-337, 2020. https://doi.org/10.1007/978-1-0716-0282-9_19

[35] T. M. Tierney *et al.*, "Optically pumped magnetometers: From quantum origins to multi-channel magnetoencephalography," *NeuroImage*, vol. 199, pp. 598-608, 2019. https://doi.org/10.1016/j.neuroimage.2019.05.063

[36] D. Niraula *et al.*, "Current status and future developments in predicting outcomes in radiation oncology," *The British Journal of Radiology*, vol. 95, no. 1139, p. 20220239, 2022. https://doi.org/10.1259/bjr.20220239

[37] A. Sinha *et al.*, "The translational paradigm of nanobiomaterials: Biological chemistry to modern applications," *Materials Today Bio*, vol. 17, p. 100463, 2022. https://doi.org/10.1016/j.mtbio.2022.100463

[38] A. Singh, "Quantum physics and quantum medicine: A systemic review and meta-analysis of understanding and recognizing diseases utilizing quantum physics and quantum medicine," Dissertation, The International Quantum University of Integrative Medicine, 2024.

[39] S. J. Lee, "The roll of complementary and alternative medicine in integrative medicine," *Hanyang Medical Reviews*, vol. 30, no. 2, pp. 75-83, 2010. https://doi.org/10.7599/hmr.2010.30.2.75

[40] G. De Benedittis, "From quantum physics to quantum hypnosis: A quantum mind perspective," *International Journal of Clinical and Experimental Hypnosis*, vol. 68, no. 4, pp. 433-450, 2020. https://doi.org/10.1080/00207144.2020.1799380

[41] R. D. Milne and R. Sorgnard, "Quantum theory underpins electromagnetic therapies for pain management," *Practical Pain Management*, vol. 1, pp. 1-7, 2013.

[42] J. Der Derian and A. Wendt, "'Quantizing international relations': The case for quantum approaches to international theory and security practice," *Security Dialogue*, vol. 51, no. 5, pp. 399-413, 2020. https://doi.org/10.1177/0967010620901905

[43] Y. S. Ra and Y. H. Kim, "On experimental confirmation of quantum physics," *Physics and High Technology*, vol. 31, pp. 8–12, 2022. https://doi.org/10.3938/PhiT.31.047

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 5: 866-883, 2025
DOI: 10.55214/25768484.v9i5.7037