

# Review: Consideration of nanomedicine, Its Past and Future, and Its Application Possibilities

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## Abstract

Nanomedicine is a field that integrates nanotechnology with medicine to revolutionize healthcare. This emerging field promises to improve medical care by facilitating biomedical research, enabling targeted drug delivery, and advancing regenerative medicine. Nanomedicine refers to the use of nanotechnology in medical applications, combining disciplines such as medicine, physics, biology, chemistry, engineering, and optics to diagnose and treat diseases in a more efficient and precise manner.

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Nanomedicine utilizes nanomaterials, such as nanoshells, nanobiosensors, nanovaccines, nanorobots, and nanocapsules, for various biomedical applications. In conclusion, nanomedicine has the potential to greatly impact healthcare by revolutionizing diagnosis, treatment, and overall medical care [9]. Furthermore, it has the potential to address current limitations in conventional therapies by offering selectivity in targeting tissues, controlled drug release, and protection against premature in vivo degradation.

**Key word:** Nanomaterial, Nanobiosensor, Nanorobot, Nanocapsule, Nanomedicine

## 1. Introduction to Nanomedicine

Nanomedicine is a field that integrates nanotechnology with medicine to revolutionize healthcare<sup>[1]</sup>. This emerging field promises to improve medical care by facilitating biomedical research, enabling targeted drug delivery, and

advancing regenerative medicine. Nanomedicine refers to the use of nanotechnology in medical applications, combining disciplines such as medicine, physics, biology, chemistry, engineering, and optics to diagnose and treat diseases in a more efficient and precise manner. Nanomedicine utilizes nanomaterials, such as nanoshells, nanobiosensors, nanovaccines, nanorobots, and nanocapsules, for various biomedical applications [2].

These nanomaterials offer potential advantages over conventional therapies, as they can enhance the effectiveness of drug delivery, provide targeted treatment to specific cells or tissues, improve disease diagnosis through advanced imaging techniques, and even enable the regeneration of damaged tissues[3]. Nanomedicine has seen a surge in research activity over the past decade and is expected to have a significant impact on the prevention, diagnosis, and treatment of diseases. Nanotechnology has the potential to revolutionize healthcare by integrating with medicine to form the field of nanomedicine. This field holds great promise for the future of healthcare, as it combines the power of nanotechnology with the knowledge and understanding of cellular and molecular functions.

Nanomedicine, with its integration of nanotechnology and medicine, has the potential to revolutionize healthcare by enhancing drug delivery, enabling targeted treatment to specific cells or tissues, improving disease diagnosis through advanced imaging techniques, and facilitating the regeneration of damaged tissues[4]. By harnessing the unique properties of nanomaterials, nanomedicine offers a range of advantages over conventional therapies[4]. These advantages include increased drug efficacy, reduced side effects, enhanced tissue penetration,

and improved molecular imaging capabilities. In addition, nanomedicine has the potential to overcome many challenges in healthcare, such as drug resistance and limited drug delivery to specific areas of the body, ultimately leading to more effective and personalized treatments for patients.

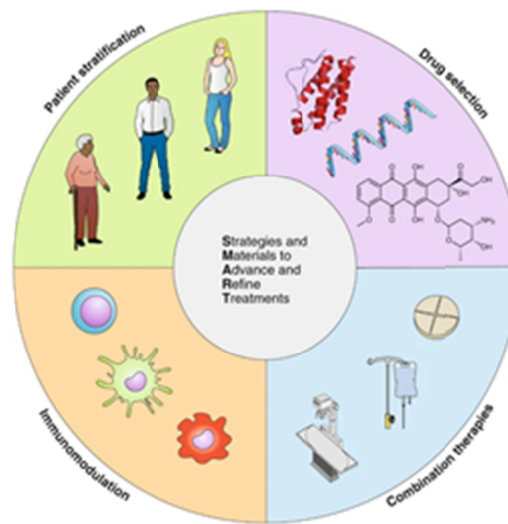


Figure 1. Smart strategies and materials to advance and refine cancer nanomedicine treatment [11].

The field of nanomedicine holds great promise for the future of healthcare, as it combines the power of nanotechnology with the knowledge and understanding of cellular.

## 2. Understanding the Concept of Nanomedicine

Understanding the concept of nanomedicine is crucial in harnessing the potential of nanotechnology for healthcare purposes. Nanomedicine involves the use of Nanotechnology in various aspects of medicine, such as drug delivery, imaging, diagnostics, and therapy [3].

Nanomedicine offers numerous advantages over traditional approaches to healthcare and medicine.

These advantages include improved drug efficacy, targeted treatment to specific cells or tissues, enhanced disease diagnosis through advanced imaging techniques, and the potential for tissue regeneration. Nanomedicine is a rapidly growing field that aims to revolutionize healthcare and medicine through the use of nanotechnology. By utilizing materials and techniques at the nanoscale, nanomedicine aims to revolutionize healthcare by providing more effective and personalized treatments<sup>[5]</sup>. Nanomedicine revolutionizes healthcare by integrating nanotechnology with medicine, offering targeted treatment, improved drug delivery, advanced imaging techniques, and potential tissue regeneration, ultimately leading to better outcomes for patients .

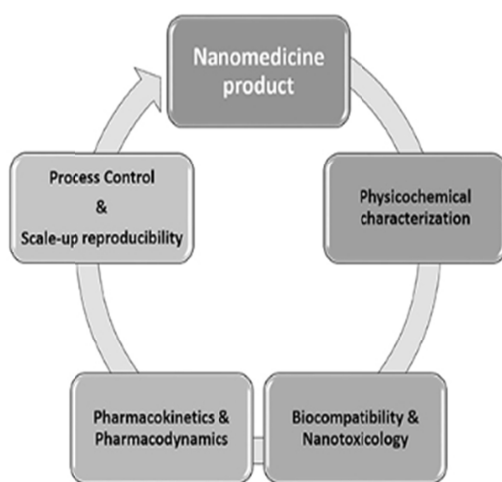


Figure 2. Development of a nanomedicine product and their process

Nanomedicine has the potential to revolutionize healthcare by utilizing nanotechnology to enhance drug delivery, target specific cells or tissues, improve disease diagnosis through advanced imaging techniques, and even facilitate tissue regeneration<sup>[1]</sup>. Overall, nanomedicine has the potential to bring significant advancements in diagnosis and treatment of diseases by utilizing

nanotechnology to improve drug efficacy, reduce side effects, improve molecular imaging capabilities, and overcome challenges in healthcare such as drug resistance and limited drug delivery to specific areas of the body .

In conclusion, nanomedicine is an emerging field that combines the power of nanotechnology with healthcare to revolutionize medicine . With the use of nanotechnology, nanomedicine holds the potential to greatly improve medical care by enhancing drug delivery, enabling targeted treatment, and advancing diagnostic

### 3. The Evolution of Nanomedicine

Nanomedicine has rapidly evolved as a field that harnesses the power of nanotechnology to revolutionize medicine and healthcare. Utilizing nanotechnology in various aspects of medicine, such as drug delivery, imaging, diagnostics, and therapy, nanomedicine offers numerous advantages over traditional approaches to healthcare and medicine. These advantages include improved drug efficacy, targeted treatment to specific cells or tissues, enhanced disease diagnosis through advanced imaging techniques, and the potential for tissue regeneration. Additionally, nanomedicine has the potential to overcome current limitations of conventional therapies by providing selectivity to target tissues, controlled drug release, and protection against degradation or elimination in the body<sup>[3]</sup>. In summary, nanomedicine is an emerging field that utilizes nanotechnology to advance medicine and healthcare by improving drug delivery, enabling targeted treatment, enhancing diagnostics and imaging, and potentially facilitating tissue regeneration<sup>[1]</sup>. Overall, nanomedicine is a promising field that has the

potential to greatly impact healthcare by improving the prevention, diagnosis, and treatment of diseases. In summary, nanomedicine is an emerging field that combines the power of nanotechnology with healthcare to revolutionize medicine. Overall, nanomedicine has the potential to bring significant advancements in diagnosis and treatment of diseases by utilizing nanotechnology to improve drug efficacy, reduce side effects, improve molecular imaging capabilities, and overcome challenges in healthcare such as drug resistance and limited drug delivery to specific areas of the body. In conclusion, nanomedicine is an emerging field that combines the power of nanotechnology with healthcare to revolutionize medicine.

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#### 4. Applications and Uses of Nanomedicine

Nanomedicine has a wide range of applications and uses in healthcare. These include: nanodiagnostics, targeted drug delivery, regenerative medicine, imaging techniques, diagnostic tools, drug delivery systems, tissue-engineered constructs, implants and pharmaceutical therapeutics, and treatments for various diseases including cardiovascular diseases, cancer, musculoskeletal conditions, psychiatric and neurodegenerative diseases, bacterial and viral infections, and diabetes. Nanomedicine has the potential to revolutionize healthcare and medicine through its diverse applications, including nanodiagnostics, targeted drug delivery, regenerative medicine, and advanced imaging

techniques. Nanomedicine has the potential to revolutionize healthcare and medicine through its diverse applications, including nanodiagnostics, targeted drug delivery, regenerative medicine, and advanced imaging techniques. Additionally, nanomedicine has the potential to overcome current limitations of conventional therapies by providing selectivity to target tissues, controlled drug release, and protection against premature inactivation<sup>[6]</sup>. Overall, nanomedicine is an emerging field that holds great potential to revolutionize medicine and healthcare by utilizing nanotechnology to enhance drug delivery, enable targeted treatment, improve diagnostics and imaging, and potentially facilitate tissue regeneration. The field of nanomedicine has seen significant research activity over the past decade, with a focus on applications such as drug delivery, in vivo imaging.

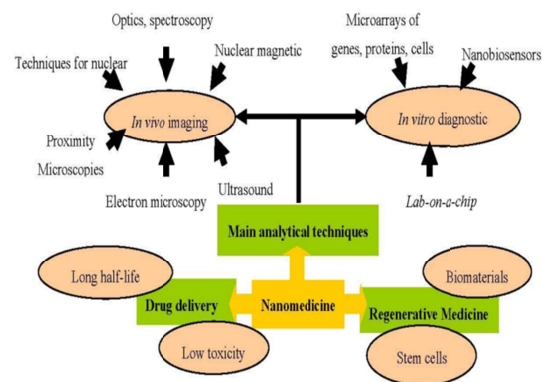


Figure 3. Application area and development prospects

#### 5. Challenges and Opportunities in Nanomedicine

Despite the promising potential of nanomedicine, there are still challenges and opportunities that need to be addressed. These include the safety and toxicity of nanomaterials, regulatory considerations,

scalability and cost-effectiveness of nanomedicine technologies, as well as ethical considerations surrounding the use of nanotechnology in medicine.

Furthermore, the integration of nanomedicine into healthcare systems will require collaboration between scientists, clinicians, regulatory bodies, and industry stakeholders. In conclusion, nanomedicine has the potential to revolutionize healthcare and medicine through its diverse applications, including nanodiagnostics, targeted drug delivery, regenerative medicine, and advanced imaging techniques. Additionally, the field of nanomedicine presents both challenges and opportunities [3].

It is crucial to address the safety and toxicity of nanomaterials, regulatory considerations, scalability and cost-effectiveness of nanomedicine technologies, as well as ethical considerations.

### 6. Recent Advances in Nanomedicine

Recent advances in nanomedicine have shown promise in addressing these challenges and maximizing the potential of nanotechnology in medicine. These advances include the development of biocompatible and biodegradable nanoparticles for drug delivery, the use of nanomaterials with controlled release properties to enhance the efficacy and safety of therapies, and the integration of nanoscale imaging techniques for early disease detection and precise treatment monitoring.

Furthermore, recent innovations in nanomedicine have also led to the development of targeted therapies, where nanoparticles are designed to selectively bind to specific cells or tissues for enhanced treatment efficacy. These targeted therapies have shown promising results in

improving the effectiveness of cancer treatments and reducing side effects.

Additionally, advancements in nanomedicine have allowed for the development of multifunctional nanoparticles that can simultaneously deliver drugs, perform imaging, and monitor therapeutic response in real time.

### 7. Nanomedicine and Healthcare

Nanomedicine has the potential to revolutionize healthcare by providing personalized and targeted treatments for various diseases [4].

These advancements in nanomedicine can lead to improved patient outcomes, reduced healthcare costs, and enhanced quality of life.

Table 1. Nanomedicine and their promising healthcare function.

Application of nanomedicine	Nanomaterial Name & Type	Pharmacological function	Diseases
Nanomedicines in the clinic	Liposome (30-100 nm)	Targeted drug Delivery	Cancer
	Nano particle (Iron oxide, 5-50 nm)	Contrast agent for magnetizing resonance imaging	Hepatic (Liver)
Nanomedicines under development	Dendrimer (5-50 nm)	Contrast agent for magnetizing resonance imaging	Cardiovascular Phase III clinical trial
	Fullerene (Carbon bucky ball 2-20 nm)	Antioxidant	Neurodegenerative, Cardiovascular
	Nanoshells (Goldcoated silica 60 nm)	Hyperthermia	Cancer Preclinical

By harnessing the power of nanotechnology, researchers are able to create innovative solutions to long-standing healthcare challenges.

These solutions include the development of nanodiagnostics, which can provide rapid and accurate disease detection, leading to earlier intervention and improved treatment outcomes. In summary, nanomedicine offers great potential in

improving healthcare through its advancements in nanodiagnostics, targeted drug delivery, regenerative medicine, advanced imaging techniques, and multifunctional nanoparticles. Furthermore, nanomedicine also brings forth regulatory considerations, scalability, and cost-effectiveness. Nanomedicine not only brings significant advances in diagnosis and treatment of diseases but also poses ethical considerations. The use of nanotechnology in medicine raises important ethical questions regarding safety, equity, and informed consent.

## 8. The Future of Nanomedicine

The future of nanomedicine holds immense promise as researchers continue to explore and develop new applications and technologies<sup>[7]</sup>. These advancements include the use of nanorobots for precise and targeted drug delivery, the development of smart implants that can monitor and adjust treatment in real time, and the integration of nanomedicine with other emerging fields such as artificial intelligence and gene therapy<sup>[3]</sup>.

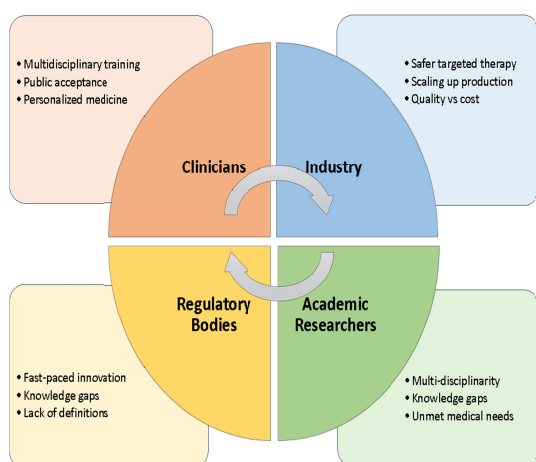


Figure 4. A future aspect on nanotechnology and their application area<sup>[11]</sup>.

With ongoing research and development, nanomedicine has the potential to revolutionize healthcare and improve patient outcomes in the future<sup>[8]</sup>.

In conclusion, nanomedicine has emerged as a powerful tool in healthcare, offering targeted drug delivery, advanced imaging techniques, and personalized treatments<sup>[6]</sup>. Its potential to simultaneously deliver drugs, perform imaging, and monitor therapeutic response in real time makes it a promising field for the future of healthcare.

## 9. Ethics and Nanomedicine

With the rapid development and implementation of nanomedicine, ethical considerations become paramount. These considerations include ensuring the safety and efficacy of nanomedicine applications, promoting equitable access to these technologies, protecting patient privacy and autonomy, and ensuring informed consent in the use of nanomedicine. Furthermore, the potential societal impact of nanomedicine must also be considered, including issues related to the distribution of resources, the potential for exacerbating existing health inequalities, and the ethical implications of enhancing human capabilities through nanotechnology. In conclusion, nanomedicine has the potential to revolutionize healthcare by overcoming current limitations in diagnosis, treatment, and management of human disease<sup>[8]</sup>.

## 10. The Impact of Nanomedicine on Modern Medicine



In summary, nanomedicine has the potential to significantly advance the field of medicine by improving diagnosis, treatment, and healthcare delivery. However, as with any new technology, ethical considerations must be carefully addressed to ensure that these advancements are used responsibly and ethically. The field of nanomedicine has the potential to revolutionize healthcare and improve patient outcomes<sup>[9]</sup>.

However, there are still several challenges that need to be addressed, such as bridging the gap between laboratory research and clinical practice, ensuring regulatory compliance and standardization, addressing biosafety concerns, and considering the cost-effectiveness of nanomedicine<sup>[10]</sup>.

Additionally, it is crucial to consider the long-term societal, economic, and ethical implications of nanomedicine to ensure that its benefits are equitably distributed and that potential risks are adequately mitigated. Nanomedicine has the potential to transform healthcare by revolutionizing diagnosis, treatment, and overall medical care<sup>[8]</sup>.

In conclusion, nanomedicine has the potential to greatly impact healthcare by revolutionizing diagnosis, treatment, and overall medical care<sup>[9]</sup>. Furthermore, it has the potential to address current limitations in conventional therapies by offering selectivity in targeting tissues, controlled drug release, and protection against premature in vivo degradation.

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