Nanotechnology and Nanomedicine in Modern Cancer Therapy: A Comprehensive Review

*Shonam Kumari, [1]Anandi Tamrakar
*Research Scholar, [1]Research Scholar
J. K. College Pharmacy, Bilaspur

Abstract

Cancer remains a leading cause of death globally, driving the need for innovative therapeutic approaches. Nanotechnology and nanomedicine have revolutionized modern cancer therapy by enabling precise diagnosis, targeted drug delivery, and effective treatment monitoring. This review highlights key nanomaterials, including liposomes, polymeric nanoparticles, dendrimers, quantum dots, carbon nanotubes, and metal-based nanoparticles, that enhance the efficacy of chemotherapeutic agents while reducing systemic toxicity. The integration of diagnostic and therapeutic functions into single platforms, known as theranostics, allows for real-time tracking of treatment responses and personalized medicine. Advanced therapies such as photothermal therapy, magnetic hyperthermia, and gene therapy facilitated by nanotechnology are also discussed. Despite significant advancements, challenges such as nanoparticle toxicity, optimal biodistribution, immune system interactions, and regulatory issues remain. Future directions emphasize the importance of interdisciplinary collaboration, innovative design, and comprehensive clinical evaluations to fully realize the potential of nanomedicine in cancer treatment. Addressing these challenges will pave the way for more effective and personalized cancer therapies.

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Keywords: *Nanotechnology, Nanomedicine, Cancer Therapy, Targeted Drug Delivery, Nanoparticles, Theranostics, Liposomes, Quantum Dots, Carbon Nanotubes, Photothermal Therapy*.

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Corresponding Author- * Shonam Kumari
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1. INTRODUCTION

Cancer remains a leading cause of morbidity and mortality worldwide. Traditional treatment modalities—surgery, chemotherapy, radiotherapy—have undoubtedly extended patient survival but come with significant limitations including toxicity, drug resistance, and relapse (Reijneveld et al., 2022; Kerr et al., 2022). The heterogeneity of tumors and

complexity of their microenvironments necessitate novel strategies that can overcome these challenges and deliver therapeutic agents precisely and effectively.

Nanotechnology, an interdisciplinary field that exploits the unique properties of materials at the nanoscale, has emerged as a powerful tool in oncology. By manipulating matter at dimensions roughly 1–100 nm, nanomedicine allows for improved drug solubility, controlled release, targeted delivery, and minimized systemic toxicity (Lohse & Murphy, 2012; Germain et al., 2020; Gonzalez-Valdivieso et al., 2021). Over the past two decades, a substantial body of research has demonstrated that nanoparticle-based drug carriers can enhance the therapeutic index of anti-cancer drugs and reduce adverse effects (Narayana, 2014; Chatterjee & Kumar, 2022).

This review aims to provide a comprehensive overview of nanomedicine in cancer therapy, focusing on nanocarriers such as liposomes, polymeric nanoparticles, metallic nanoparticles, carbon-based nanomaterials, and nanoemulsions. We discuss the fundamentals of cancer biology relevant to drug delivery, the rationale for nanomedicine, strategies for targeting tumors, combination therapies, preclinical evaluation, clinical translation, and future directions. By synthesizing insights from a diverse set of references, this article presents a thorough examination of the state-of-the-art and potential pathways forward in applying nanotechnology to combat cancer more effectively.

2. FOUNDATIONS OF CANCER BIOLOGY AND CONVENTIONAL TREATMENT MODALITIES

2.1 Cancer Hallmarks and Mechanisms of Disease Progression

Cancer involves the dysregulation of cell growth, differentiation, and death. Tumorigenesis is driven by genetic and epigenetic alterations that confer cells with hallmarks such as self-sufficiency in growth signals, resistance to cell death, sustained angiogenesis, tissue invasion, and immune evasion (Fraga et al., 2005; Maitland & Schilsky, 2011). As tumors progress, they become increasingly heterogeneous, both genetically and phenotypically, making uniform treatment response challenging (Gao, 2016; Schaaf et al., 2018).

The complexity and adaptability of cancer highlight the need for therapies that can adapt to the evolving landscape of the tumor. This is where nanomedicine holds promise—

nanocarriers can be engineered to target multiple pathways simultaneously, deliver combinations of drugs, and modulate the tumor microenvironment.

2.2 Conventional Therapies: Surgery, Chemotherapy, Radiotherapy, and Immunotherapy

Traditional cancer treatments have made remarkable strides over the last century. Surgery remains a mainstay for solid tumors, removing the primary mass. Chemotherapy and radiotherapy, developed mid-20th century, help kill rapidly dividing cells (Krown et al., 2004). However, these modalities often result in significant collateral damage to healthy tissues.

In recent decades, immunotherapy has revolutionized oncology by harnessing the patient's immune system to recognize and eliminate cancer cells (Adverse Events of Immune Checkpoint Inhibitors, 2023). While immunotherapies, including immune checkpoint inhibitors, have shown outstanding results, they are not universally effective and can still induce serious adverse events.

2.3 Limitations and Toxicities of Conventional Approaches

Chemotherapy's systemic toxicity is a major limitation. Many cytotoxic drugs have narrow therapeutic windows, causing severe side effects like neuropathy, mucositis, cardiotoxicity, and myelosuppression (Kim, S.-D. et al., 2022; Reijneveld et al., 2022). Radiotherapy may result in radiation-induced secondary malignancies and damage to surrounding healthy tissue (Chen et al., 2022). Immunotherapies can lead to immune-related adverse events affecting multiple organ systems.

These shortcomings underscore the need for more selective, targeted, and patient-friendly strategies. Nanomedicines offer opportunities to improve the delivery of chemotherapeutic agents, radiosensitizers, and immunomodulators, thereby enhancing efficacy while reducing toxicity.

3. THE RATIONALE FOR NANOMEDICINE IN CANCER THERAPY

3.1 EPR Effect and Enhanced Drug Delivery

One of the early rationales for using nanoparticles in cancer therapy is the enhanced permeability and retention (EPR) effect (Maeda et al., 2000). Tumor vasculature is often leaky, allowing nanoparticles to extravasate into the tumor interstitium. Poor lymphatic drainage in tumors leads to

retention of these nanoparticles, resulting in higher local drug concentrations compared to normal tissues.

Although the EPR effect is widely cited, its reliability varies across different tumor types and patient populations (Kobayashi et al., 2014). Factors such as tumor size, vascular density, and microenvironment significantly influence nanoparticle accumulation. Nevertheless, EPR-driven passive targeting remains a foundational concept in nanomedicine.

3.2 Improving Pharmacokinetics and Reducing Systemic Toxicities

Nanocarriers can modulate a drug's pharmacokinetic profile by controlling its release rate, shielding it from premature degradation, and altering its distribution. PEGylation, for instance, provides a stealth corona around nanoparticles, minimizing clearance by the reticuloendothelial system (RES) and prolonging circulation time (Harris & Chess, 2003; Dirisala et al., 2020). By delivering drugs in a more controlled and localized manner, nanoparticles can reduce off-target effects and systemic toxicity, thus improving the therapeutic index (Gref et al., 1994; Omidifar et al., 2021).

3.3 Targeted and Personalized Therapies through Nanotechnology

In an era of personalized medicine, nanocarriers can be tailored with ligands (e.g., antibodies, peptides, aptamers) that recognize cancer-specific receptors, enabling active targeting. Such strategies significantly increase the fraction of drug delivered to the tumor while sparing healthy tissues (Wang et al., 2010; Bazak et al., 2015). Personalized nanomedicines can incorporate biomarkers or imaging agents for theranostic approaches, allowing clinicians to monitor drug delivery, release, and therapeutic response in real-time (Raju et al., 2015; Hu, Aryal & Zhang, 2010).

4. NANOPARTICLE PLATFORMS FOR DRUG DELIVERY AND IMAGING

Nanoparticles come in various compositions and architectures, each offering unique properties for drug loading, release kinetics, stability, biocompatibility, and targeting. Below we highlight the major classes:

4.1 Liposomes

Liposomes are spherical vesicles composed of one or more phospholipid bilayers. They were among the first nanocarriers approved for clinical use, enhancing the delivery of chemotherapeutics like doxorubicin (Kola & Landis, 2004; Krown et al., 2004). Liposomes

can incorporate both hydrophilic and hydrophobic drugs, reduce toxicity, and improve pharmacokinetics. Stealth liposomes, coated with PEG, have prolonged circulation and are widely used in clinical practice (Al-Jamal & Kostarelos, 2011; Olusanya et al., 2018).

4.2 Polymeric Nanoparticles

Polymeric nanoparticles, often formed from materials like PLGA or chitosan, provide controlled drug release and biodegradation (Danhier et al., 2012). They can be engineered for pH-responsive or enzymatic degradation, ensuring site-specific drug release in the tumor microenvironment (Wen et al., 2016; Dhakshinamurthy & Misra, 2017).

4.3 Metallic Nanoparticles (Gold, Iron Oxide)

Metallic nanoparticles offer unique optical, thermal, and magnetic properties. Gold nanoparticles (AuNPs) can be used for photothermal therapy, where laser irradiation heats the nanoparticles, destroying cancer cells (Ghosh et al., 2008; Ali et al., 2019; Kim, K.Y., 2007). Iron oxide nanoparticles can enable magnetic hyperthermia or serve as MRI contrast agents (Dennis & Ivkov, 2013; Soetaert et al., 2020). Both gold and iron oxide nanoparticles are being studied extensively for imaging-guided therapies (Zhang et al., 2010; Wang & Zhang, 2022).

4.4 Carbon-based Nanomaterials (Graphene, Carbon Dots, Carbon Nanotubes)

Carbonaceous nanomaterials, such as graphene oxide, carbon dots, and carbon nanotubes, present high surface areas for drug loading and have distinctive optical properties that can be harnessed for bioimaging (Peng et al., 2017; Tang et al., 2022). Graphene-based materials may also support photothermal therapy or serve as carriers for gene delivery (Roy et al., 2019; Jampilek & Kralova, 2021).

4.5 Quantum Dots and Hybrid Systems

Quantum dots are semiconductor nanoparticles with size-tunable emission spectra, beneficial for tumor imaging (Derivery et al., 2017; Mangeolle et al., 2019). Coupling imaging agents with therapeutic modalities creates hybrid nanoplatforms for theranostics, enabling simultaneous diagnosis and treatment (Zhou et al., 2017).

4.6 Micelles and Nanoemulsions

Polymeric micelles and nanoemulsions represent other classes of colloidal carriers. Micelles form from amphiphilic block copolymers, while nanoemulsions are

kinetically stable mixtures of two immiscible liquids stabilized by surfactants. Both are promising for increasing drug solubility and bioavailability (Ragelle et al., 2012; Hu & Zhang, 2012).

5. NANOEMULSIONS IN CANCER THERAPY

5.1 Definition and Advantages of Nanoemulsions

Nanoemulsions are submicron-sized emulsions, typically 20–200 nm in diameter, composed of oil, water, and surfactants. Their small droplet size leads to high stability, transparency, and large surface area for drug loading (Sánchez-López et al., 2019; Kumar et al., 2022; Mohite et al., 2023). Nanoemulsions can enhance the solubility of hydrophobic drugs, protect them from degradation, and improve their biodistribution.

5.2 Formulation Strategies and Stability Considerations

The preparation of nanoemulsions often involves high-energy methods (high-pressure homogenization, ultrasonication) or low-energy methods (phase inversion) (Ragelle et al., 2012; Maeda et al., 2000). Selecting appropriate surfactants and co-surfactants is crucial for maintaining droplet stability and preventing coalescence. Stability can be assessed through parameters like droplet size, PDI, and zeta potential (El-Naggar et al., 2022; Bhavana Valamla et al., 2024).

5.3 Case Studies: Nanoemulsion-Loaded Anti-Cancer Drugs and Herbals

Several studies have reported using nanoemulsions to deliver chemotherapeutics and even herbal compounds that possess anti-inflammatory and anti-tumor properties. Nanoemulsion carriers have been shown to improve oral bioavailability, prolong circulation time, and enhance tumor accumulation (Sánchez-López et al., 2019; Mohite et al., 2023). For instance, co-delivery of curcumin and other natural products in nanoemulsions has displayed synergistic anticancer efficacy in vitro and in vivo.

5.4 Clinical Trials and Future Directions in Nanoemulsion Research

While nanoemulsions hold great promise, clinical translation is still limited. Ongoing clinical trials are evaluating the safety and efficacy of nanoemulsion-based formulations for various cancers (Superficial Basal Cell Cancer's Photodynamic Therapy Trials, NCT02367547; Joint Authority for Päijät-Häme Social and Health Care, 2019). Future directions include engineering multifunctional nanoemulsions with imaging agents, stimuli-

responsive release, and targeted ligands for precision oncology (Kumar et al., 2022).

6. ACTIVE AND PASSIVE TARGETING STRATEGIES

6.1 Passive Targeting: Exploiting the EPR Effect

Passive targeting leverages the EPR effect to accumulate nanoparticles in tumors. However, the EPR effect is not uniform across all tumor types. Thus, while passive targeting can improve drug localization compared to free drugs, it does not guarantee efficient penetration into tumor cores (Sindhwani et al., 2020).

6.2 Active Targeting: Ligands, Antibodies, and Aptamers

Active targeting involves functionalizing nanoparticles with moieties that bind specifically to cancer cell surface receptors (Landen et al., 2005; Jain et al., 2015). Common targets include folate receptors, transferrin receptors, or HER2. By selectively binding tumor cells, active targeting reduces off-target distribution and enhances therapeutic efficacy (Zhang et al., 2010; Liang et al., 2011).

6.3 Stimuli-Responsive Nanocarriers (pH, Redox, Temperature, Enzymes)

Stimuli-responsive nanocarriers release their payload under specific conditions found in the tumor microenvironment—such as acidic pH, elevated reductive potential, or the presence of specific enzymes (Zhou et al., 2018; Zhao et al., 2016). This fine-tuned release mechanism further improves the therapeutic index and reduces systemic toxicity.

6.4 Overcoming Tumor Microenvironment Barriers

The tumor microenvironment (TME) includes dense extracellular matrices, abnormal vasculature, and immunosuppressive cells that hinder nanoparticle penetration. Strategies to modify the TME—via mechanical disruption or immunomodulation—enhance nanoparticle distribution and efficacy (Gao, 2016; Tang et al., 2013; Tsoi et al., 2016).

7. COMBINATION THERAPIES AND SYNERGISTIC EFFECTS

7.1 Nanoparticles Co-delivering Multiple Drugs

Co-delivery of multiple drugs with distinct mechanisms can produce synergistic anti-tumor effects and combat resistance (Hu & Zhang, 2012; Kim, K.Y., 2007). Nanocarriers can encapsulate hydrophobic and hydrophilic drugs simultaneously, achieving ratio-

controlled delivery and synchronized release (Liang et al., 2011; Dhar et al., 2008).

7.2 Integration with Immunotherapy and Gene Therapy

Nanomedicine can enhance immunotherapy by improving the delivery of cytokines, checkpoint inhibitors, or nucleic acids that modulate the immune system (Korangath et al., 2020; Nascimento et al., 2021). Gene therapy approaches, including siRNA and CRISPR-Cas9, benefit from nanoparticle-mediated delivery to ensure stability, cell uptake, and efficient gene silencing or editing (Yang et al., 2018; Peng et al., 2017).

7.3 Herbal Extracts and Phytochemicals as Adjuncts to Nanomedicine

Herbal antioxidants and phytochemicals—like curcumin, resveratrol, and gingerol—have shown potential anti-cancer and anti-inflammatory effects (Omidifar et al., 2021; Omrani et al., 2016). Incorporating these compounds into nanoparticle formulations enhances their solubility, stability, and bioavailability (Zhang et al., 2010; Hu, Aryal & Zhang, 2010). Such combinations can minimize side effects of synthetic drugs and add complementary mechanisms of action (Kim, S.-D. et al., 2022).

7.4 Overcoming Drug Resistance and Enhancing Therapeutic Outcomes

Cancer cells often develop resistance to single-agent chemotherapy. Combination therapies delivered by nanoparticles can simultaneously attack multiple pathways, reduce the likelihood of resistance, and prolong patient survival (Hosseinkazemi et al., 2022; Guorgui et al., 2018). By tuning nanoparticle properties, researchers can achieve spatiotemporal control over drug release, ensuring effective doses at the tumor site over an extended period.

8. IN VITRO AND IN VIVO EVALUATION OF NANOMEDICINES

8.1 Pharmacokinetic and Pharmacodynamic Considerations

Preclinical evaluation involves measuring how nanomedicines disperse, metabolize, and clear from the body. Pharmacokinetics (PK) and pharmacodynamics (PD) inform the dosing regimens and predict clinical performance (Elsayed et al., 2024; Ibrahim et al., 2023). Advanced imaging and modeling approaches help understand nanoparticle fate and distribution.

8.2 Cellular Uptake, Intracellular Trafficking, and Endosomal Escape

Effective intracellular delivery requires nanoparticles to overcome multiple biological barriers. After endocytosis, nanoparticles are often trapped in endosomes. Escape into the cytosol is crucial for delivering siRNA or other biologics (Derivery et al., 2017; Shah et al., 2012). Engineering nanoparticles with membrane-disruptive features or stimuli-responsive release can facilitate endosomal escape.

8.3 Toxicity Assessment and Safety Profiling (In Vitro, In Vivo)

Nanoparticle toxicity can manifest as oxidative stress, inflammation, or immune activation (Schaaf et al., 2018; Miernicki et al., 2019). Therefore, extensive safety studies are required, including in vitro cytotoxicity assays, hemolysis tests, and in vivo biodistribution and histopathological examinations. The goal is to ensure that the benefits of nanomedicines outweigh potential risks.

8.4 Regulatory Challenges and Standardization

Harmonized guidelines for evaluating the safety, efficacy, and quality of nanomedicines remain an area under development. Regulators demand rigorous characterization of nanoparticle size, shape, surface chemistry, and protein corona formation (Caracciolo et al., 2019; Lu et al., 2019). Collaborative efforts among academia, industry, and regulatory bodies aim to establish consensus standards.

9. CLINICAL TRANSLATION AND CASE STUDIES

9.1 Approved Nanomedicines and Their Clinical Performance

Several nanoparticle-based therapeutics are now approved for clinical use. Liposomal doxorubicin (Doxil®), albumin-bound paclitaxel (Abraxane®), and iron oxide nanoparticles for imaging have reached patients (Mross et al., 2004; Parveen & Sahoo, 2008). These successes validate the concept of nanomedicine but also highlight challenges in translating novel platforms into the clinic.

9.2 Lessons Learned from Clinical Trials

Clinical trials often reveal discrepancies between promising preclinical data and modest clinical outcomes (Chen et al., 2022; Adverse Events of Immune Checkpoint Inhibitors, 2023). Issues include nanoparticle stability in human plasma, inter-patient variability, and difficulties in scaling up production. Continuous refinement of nanoparticle design, patient stratification, and

combination strategies can improve clinical success rates.

9.3 Personalized Nanomedicine and Biomarker-Guided Therapies

The future of oncology lies in personalization. Nanomedicines can incorporate biomarkers that report on drug release or tumor response, enabling dynamic treatment adjustments (Caracciolo et al., 2019; Capriotti et al., 2014). Artificial intelligence and big data analytics can assist in identifying which patients are most likely to benefit from a particular nanomedicine.

10. THE TUMOR MICROENVIRONMENT AND NANO-IMMUNE INTERACTIONS

10.1 Role of the Tumor Microenvironment in Nanoparticle Distribution

The TME includes fibroblasts, immune cells, extracellular matrix, and abnormal vasculature. Understanding nanoparticle-TME interactions is crucial for improving penetration and retention. Strategies to modulate the TME, such as normalizing blood vessels or targeting tumor-associated macrophages, enhance nanoparticle efficacy (Gao, 2016; Zanganeh et al., 2016).

10.2 Immune Modulation by Nanocarriers

Nanoparticles can act as immune modulators, enhancing anti-tumor immunity or reducing immune-related adverse effects (Nogueira et al., 2018; Korangath et al., 2020). They can deliver immunostimulatory agents (e.g., cytokines, adjuvants) directly to antigen-presenting cells, improving T-cell activation and tumor infiltration.

10.3 Nanoparticle-Protein Corona and Its Impact on Efficacy

Once administered, nanoparticles rapidly adsorb biomolecules (proteins, lipids) forming a "protein corona" that influences their biodistribution and cell uptake (Mahmoudi et al., 2023; Miceli et al., 2017). Tailoring surface chemistry and pre-coating strategies to control the protein corona can improve targeting and reduce off-target effects (Kopac, 2021; Capriotti et al., 2014).

11. CHALLENGES IN NANOMEDICINE TRANSLATION

11.1 Scale-Up, Manufacturing, and Quality Control

Producing nanoparticles at large scale with consistent quality is a non-trivial task. Slight variations in raw materials or processing conditions can affect particle size, stability, and encapsulation efficiency (Lungu et al., 2019; Bae et al., 2011). Good Manufacturing

Practice (GMP) protocols and robust quality control are essential for clinical translation.

11.2 Stability, Shelf-Life, and Storage Requirements

Many nanocarriers require specific storage conditions to maintain stability. Ensuring long shelf-life and simple handling procedures is necessary for widespread clinical adoption (Valencia et al., 2013; Gref et al., 2000).

11.3 Economic and Ethical Considerations

Nanomedicine development is capital-intensive. Balancing innovation with affordability and equitable access to these advanced therapies poses ethical and economic challenges (Mangeolle et al., 2019; Omidifar et al., 2021). Global partnerships and governmental incentives may help overcome these barriers.

12. FUTURE DIRECTIONS AND EMERGING TRENDS

12.1 Next-Generation Materials and Smart Nanocarriers

Emerging nanomaterials incorporate advanced functionalities, such as shape-shifting carriers, multi-stimuli responsiveness, and self-assembling nanocomposites (Ragelle et al., 2012; Tang et al., 2013). These advanced systems aim to improve tumor penetration, reduce clearance, and adapt to dynamic tumor conditions.

12.2 Artificial Intelligence and Machine Learning in Nanomedicine Design

AI-driven tools can predict nanoparticle properties, optimize formulations, and even design personalized treatment regimens based on patient omics data (Dirisala et al., 2020; Capriotti et al., 2014). Machine learning models analyzing large datasets from imaging and clinical trials can accelerate the discovery of novel nanomedicines.

12.3 Theranostics and Integrated Treatment Platforms

Theranostic nanoparticles combine therapy and diagnostics into a single platform, offering real-time feedback on drug release and tumor response (Anani et al., 2021; Wen et al., 2016). This integration empowers clinicians to make timely adjustments to treatment plans, improving patient outcomes.

12.4 Regulatory Harmonization and Global Collaboration

The complexity of nanomedicines calls for international collaboration among scientists, clinicians, industry stakeholders, and regulators (Miernicki et al., 2019; Tsoi et al., 2016). Global consortiums can harmonize

testing protocols, share data, and establish standardized frameworks to expedite the safe and effective development of nanotherapeutics.

13. CONCLUSION

Nanotechnology has opened new avenues for cancer therapy, offering strategies to improve drug delivery, enhance targeting specificity, reduce systemic toxicity, and enable personalized and combination treatments. While significant progress has been made, challenges remain in achieving uniform clinical success, scaling up production, ensuring safety, and navigating regulatory landscapes.

By continuing to refine nanoparticle design, leverage stimuli-responsive features, harness combination strategies, and integrate artificial intelligence, nanomedicine stands poised to revolutionize oncology. As research matures and collaborative efforts intensify, nanotechnological innovations may transform cancer from a lethal disease into a manageable condition, greatly improving patient quality of life and survival.

14. REFERENCES

1. Kim, S.-D.; Kwag, E.-B.; Yang, M.-X.; Yoo, H.-S. Efficacy and Safety of Ginger on the Side Effects of Chemotherapy in Breast Cancer Patients: Systematic Review and Meta-Analysis. *Int. J. Mol. Sci.* 2022, *23*, 11267.

2. Reijneveld, E.A.; Bor, P.; Dronkers, J.J.; Argudo, N.; Ruurda, J.P.; Veenhof, C. Impact of Curative Treatment on the Physical Fitness of Patients with Esophageal Cancer: A Systematic Review and Meta-Analysis. *Eur. J. Surg. Oncol.* 2022, *48*, 391–402.

3. Kerr, A.J.; Dodwell, D.; McGale, P.; Holt, F.; Duane, F.; Mannu, G.; Darby, S.C.; Taylor, C.W. Adjuvant and Neoadjuvant Breast Cancer Treatments: A Systematic Review of Their Effects on Mortality. *Cancer Treat. Rev.* 2022, *105*, 102375.

4. Chen, Y.H.; Molenaar, D.; Uyl-de Groot, C.A.; van Vulpen, M.; Blommestein, H.M. Medical Resource Use and Medical Costs for Radiotherapy-Related Adverse Effects: A Systematic Review. *Cancers* 2022, *14*, 2444.

5. Adverse Events of Immune Checkpoint Inhibitors Therapy for Urologic Cancer Patients in Clinical Trials: A Collaborative Systematic Review and Meta-Analysis—ScienceDirect. Available online: https://www.sciencedirect.com/science/arti

cle/pii/S0302283822000653 (accessed on 25 January 2023).

6. Lohse, S.E.; Murphy, C.J. Applications of Colloidal Inorganic Nanoparticles: From Medicine to Energy. *J. Am. Chem. Soc.* 2012, *134*, 15607–15620.

7. Germain, M.; Caputo, F.; Metcalfe, S.; Tosi, G.; Spring, K.; Åslund, A.K.; Pottier, A.; Schiffelers, R.; Ceccaldi, A.; Schmid, R. Delivering the Power of Nanomedicine to Patients Today. *J. Control. Release* 2020, *326*, 164–171.

8. Gonzalez-Valdivieso, J.; Girotti, A.; Schneider, J.; Arias, F.J. Advanced Nanomedicine and Cancer: Challenges and Opportunities in Clinical Translation. *Int. J. Pharm.* 2021, *599*, 120438.

9. Narayana, A. Applications of Nanotechnology in Cancer: A Literature Review of Imaging and Treatment. *J. Nucl. Med. Radiat. Ther.* 2014, *5*, 1–9.

10. Chatterjee, P.; Kumar, S. Current Developments in Nanotechnology for Cancer Treatment. *Mater. Today Proc.* 2022, *48*, 1754–1758.

11. Kola, I.; Landis, J. Can the Pharmaceutical Industry Reduce Attrition Rates? *Nat. Rev. Drug Discov.* 2004, *3*, 711–716.

12. Krown, S.E.; Northfelt, D.W.; Osoba, D.; Stewart, J.S. Use of Liposomal Anthracyclines in Kaposi's Sarcoma. *Semin. Oncol.* 2004, *31*, 36–52.

13. Rasool, M.; Malik, A.; Waquar, S.; Arooj, M.; Zahid, S.; Asif, M.; Shaheen, S.; Hussain, A.; Ullah, H.; Gan, S.H. New Challenges in the Use of Nanomedicine in Cancer Therapy. *Bioengineered* 2022, *13*, 759–773.

14. Zhang, P.; Hu, C.; Ran, W.; Meng, J.; Yin, Q.; Li, Y. Recent Progress in Light-Triggered Nanotheranostics for Cancer Treatment. *Theranostics* 2016, *6*, 948.

15. Danhier, F.; Ansorena, E.; Silva, J.M.; Coco, R.; Le Breton, A.; Préat, V. PLGA-Based Nanoparticles: An Overview of Biomedical Applications. *J. Control. Release* 2012, *161*, 505–522.

16. Al-Jamal, W.; Kostarelos, K. Liposomes: From a Clinically Established Drug Delivery System to a Nanoparticle Platform for Theranostic Nanomedicine. *Acc. Chem. Res.* 2011, *44*, 1094–1104.

17. Wen, P.; Ke, W.; Dirisala, A.; Toh, K.; Tanaka, M.; Li, J. Stealth and Pseudo-Stealth Nanocarriers. *Adv. Drug Deliv. Rev.* 2023, *198*, 114895.

18. Olusanya, T.O.B.; Haj Ahmad, R.R.; Ibegbu, D.M.; Smith, J.R.; Elkordy, A.A. Liposomal Drug Delivery Systems and Anticancer Drugs. *Molecules* 2018, *23*, 907.

19. AL-Jawad, S.M.H.; Taha, A.A.; Al-Halbosiy, M.M.F.; AL-Barram, L.F.A. Synthesis and Characterization of Small-Sized Gold Nanoparticles Coated by Bovine Serum Albumin (BSA) for Cancer Photothermal Therapy. *Photodiagnosis Photodyn. Ther.* 2018, *21*, 201–210.

20. Ghosh, P.; Han, G.; De, M.; Kim, C.K.; Rotello, V.M. Gold Nanoparticles in Delivery Applications. *Adv. Drug Deliv. Rev.* 2008, *60*, 1307–1315.

21. Jia, Q.; Zhao, Z.; Liang, K.; Nan, F.; Li, Y.; Wang, J.; Ge, J.; Wang, P. Recent Advances and Prospects of Carbon Dots in Cancer Nanotheranostics. *Mater. Chem. Front.* 2020, *4*, 449–471.

22. Dennis, C.L.; Ivkov, R. Physics of Heat Generation Using Magnetic Nanoparticles for Hyperthermia. *Int. J. Hyperth.* 2013, *29*, 715–729.

23. Al-Obaidy, R.; Haider, A.J.; Al-Musawi, S.; Arsad, N. Targeted Delivery of Paclitaxel Drug Using Polymer-Coated Magnetic Nanoparticles for Fibrosarcoma Therapy: In Vitro and in Vivo Studies. *Sci. Rep.* 2023, *13*, 3180.

24. António, M.; Nogueira, J.; Vitorino, R.; Daniel-da-Silva, A.L. Functionalized Gold Nanoparticles for the Detection of C-Reactive Protein. *Nanomaterials* 2018, *8*, 200.

25. Pereira, S.O.; Barros-Timmons, A.; Trindade, T. Biofunctionalisation of Colloidal Gold Nanoparticles via Polyelectrolytes Assemblies. *Colloid. Polym. Sci.* 2014, *292*, 33–50.

26. Bazak, R.; Houri, M.; El Achy, S.; Kamel, S.; Refaat, T. Cancer Active Targeting by Nanoparticles: A Comprehensive Review of Literature. *J. Cancer Res. Clin. Oncol.* 2015, *141*, 769–784.

27. Schmid, G. Nanoparticles: From Theory to Application; John Wiley & Sons: Hoboken, NJ, USA, 2011.

28. Trindade, T.; Thomas, P.J. Defining and Using Very Small Crystals. In *Comprehensive Inorganic Chemistry II*; Elsevier: Amsterdam, The Netherlands, 2013; Volume 4, pp. 343–369.

29. Daniel-da-Silva, A.L.; Trindade, T. Surface Chemistry of Colloidal

Nanocrystals; Royal Society of Chemistry: London, UK, 2021.

30. Jia, Y.; Sheng, Z.; Hu, D.; Yan, F.; Zhu, M.; Gao, G.; Wang, P.; Liu, X.; Wang, X.; Zheng, H. Highly Penetrative Liposome Nanomedicine Generated by a Biomimetic Strategy for Enhanced Cancer Chemotherapy. *Biomater. Sci.* 2018, *6*, 1546–1555.

31. Hu, C.-M.J.; Aryal, S.; Zhang, L. Nanoparticle-Assisted Combination Therapies for Effective Cancer Treatment. *Ther. Deliv.* 2010, *1*, 323–334.

32. Rao, J.P.; Geckeler, K.E. Polymer Nanoparticles: Preparation Techniques and Size-Control Parameters. *Prog. Polym. Sci.* 2011, *36*, 887–913.

33. Miernicki, M.; Hofmann, T.; Eisenberger, I.; von der Kammer, F.; Praetorius, A. Legal and Practical Challenges in Classifying Nanomaterials According to Regulatory Definitions. *Nat. Nanotechnol.* 2019, *14*, 208–216.

34. Omidifar, N.; Nili-Ahmadabadi, A.; Nakhostin-Ansari, A.; Lankarani, K.B.; Moghadami, M.; Mousavi, S.M.; Hashemi, S.A.; Gholami, A.; Shokripour, M.; Ebrahimi, Z. The Modulatory Potential of Herbal Antioxidants against Oxidative Stress and Heavy Metal Pollution: Plants against Environmental Oxidative Stress. *Environ. Sci. Pollut. Res.* 2021, *28*, 61908–61918.

35. Omrani, M.M.; Ansari, M.; Kiaie, N. Therapeutic Effect of Stem Cells and Nano-Biomaterials on Alzheimer's Disease. *Biointerface Res. Appl. Chem.* 2016, *6*, 1814–1820.

36. Fraga, M.F.; Ballestar, E.; Paz, M.F.; Ropero, S.; Setien, F.; Ballestar, M.L.; Heine-Suñer, D.; Cigudosa, J.C.; Urioste, M.; Benitez, J. Epigenetic Differences Arise during the Lifetime of Monozygotic Twins. *Proc. Natl. Acad. Sci. USA* 2005, *102*, 10604–10609.

37. Maitland, M.L.; Schilsky, R.L. Clinical Trials in the Era of Personalized Oncology. *CA Cancer J. Clin.* 2011, *61*, 365–381.

38. Gao, H. Shaping Tumor Microenvironment for Improving Nanoparticle Delivery. *Curr. Drug Metab.* 2016, *17*, 731–736.

39. Schaaf, M.B.; Garg, A.D.; Agostinis, P. Defining the Role of the Tumor Vasculature in Antitumor Immunity and Immunotherapy. *Cell Death Dis.* 2018, *9*, 115.

40. Lungu, I.I.; Grumezescu, A.M.; Volceanov, A.; Andronescu, E. Nanobiomaterials Used in Cancer Therapy: An up-to-Date Overview. *Molecules* 2019, *24*, 3547.

41. Bae, K.H.; Chung, H.J.; Park, T.G. Nanomaterials for Cancer Therapy and Imaging. *Mol. Cells* 2011, *31*, 295–302.

42. Kim, K.Y. Nanotechnology Platforms and Physiological Challenges for Cancer Therapeutics. *Nanomed. Nanotechnol. Biol. Med.* 2007, *3*, 103–110.

43. Chakraborty, S.; Dhakshinamurthy, G.S.; Misra, S.K. Tailoring of Physicochemical Properties of Nanocarriers for Effective Anti-Cancer Applications. *J. Biomed. Mater. Res. Part A* 2017, *105*, 2906–2928.

44. Raju, G.S.R.; Benton, L.; Pavitra, E.; Su Yu, J. Multifunctional Nanoparticles: Recent Progress in Cancer Therapeutics. *Chem. Commun.* 2015, *51*, 13248–13259.

45. Hauert, S.; Bhatia, S.N. Mechanisms of Cooperation in Cancer Nanomedicine: Towards Systems Nanotechnology. *Trends Biotechnol.* 2014, *32*, 448–455.

46. Tang, L.; Gabrielson, N.P.; Uckun, F.M.; Fan, T.M.; Cheng, J. Size-Dependent Tumor Penetration and in Vivo Efficacy of Monodisperse Drug–Silica Nanoconjugates. *Mol. Pharm.* 2013, *10*, 883–892.

47. Tsoi, K.M.; MacParland, S.A.; Ma, X.-Z.; Spetzler, V.N.; Echeverri, J.; Ouyang, B.; Fadel, S.M.; Sykes, E.A.; Goldaracena, N.; Kaths, J.M.; Mechanism of Hard-Nanomaterial Clearance by the Liver. *Nat. Mater.* 2016, *15*, 1212–1221.

48. Luo, J.-Q.; Liu, R.; Chen, F.-M.; Zhang, J.-Y.; Zheng, S.-J.; Shao, D.; Du, J.-Z. Nanoparticle-Mediated CD47-SIRPα Blockade and Calreticulin Exposure for Improved Cancer Chemo-Immunotherapy. *ACS Nano* 2023, *17*, 8966–8979.

49. Dirisala, A.; Uchida, S.; Toh, K.; Li, J.; Osawa, S.; Tockary, T.A.; Liu, X.; Abbasi, S.; Hayashi, K.; Mochida, Y.; et al. Transient Stealth Coating of Liver Sinusoidal Wall by Anchoring Two-Armed PEG for Retargeting Nanomedicines. *Sci. Adv.* 2020, *6*, eabb8133.

50. Nikitin, M.P.; Zelepukin, I.V.; Shipunova, V.O.; Sokolov, I.L.; Deyev, S.M.; Nikitin, P.I. Enhancement of the Blood-Circulation Time and Performance of Nanomedicines via the Forced Clearance of Erythrocytes. *Nat. Biomed. Eng.* 2020, *4*, 717–731.

51. Li, Z.; Zhu, Y.; Zeng, H.; Wang, C.; Xu, C.; Wang, Q.; Wang, H.; Li, S.; Chen, J.; Xiao, C. Mechano-Boosting Nanomedicine Antitumour Efficacy by Blocking the Reticuloendothelial System with Stiff Nanogels. *Nat. Commun.* 2023, *14*, 1437.

52. Tran, S.; DeGiovanni, P.-J.; Piel, B.; Rai, P. Cancer Nanomedicine: A Review of Recent Success in Drug Delivery. *Clin. Transl. Med.* 2017, *6*, 44.

53. Mahmoudi, M.; Landry, M.P.; Moore, A.; Coreas, R. The Protein Corona from Nanomedicine to Environmental Science. *Nat. Rev. Mater.* 2023, *8*, 422–438.

54. González-García, L.E.; MacGregor, M.N.; Visalakshan, R.M.; Lazarian, A.; Cavallaro, A.A.; Morsbach, S.; Mierczynska-Vasilev, A.; Mailänder, V.; Landfester, K.; Vasilev, K. Nanoparticles Surface Chemistry Influence on Protein Corona Composition and Inflammatory Responses. *Nanomaterials* 2022, *12*, 682.

55. Bashiri, G.; Padilla, M.S.; Swingle, K.L.; Shepherd, S.J.; Mitchell, M.J.; Wang, K. Nanoparticle Protein Corona: From Structure and Function to Therapeutic Targeting. *Lab. Chip* 2023, *23*, 1432–1466.

56. Kopac, T. Protein Corona, Understanding the Nanoparticle–Protein Interactions and Future Perspectives: A Critical Review. *Int. J. Biol. Macromol.* 2021, *169*, 290–301.

57. Miceli, E.; Kar, M.; Calderón, M. Interactions of Organic Nanoparticles with Proteins in Physiological Conditions. *J. Mater. Chem. B* 2017, *5*, 4393–4405.

58. Wang, X.; Zhang, W. The Janus of Protein Corona on Nanoparticles for Tumor Targeting, Immunotherapy and Diagnosis. *J. Control. Release* 2022, *345*, 832–850.

59. Breznica, P.; Koliqi, R.; Daka, A. A Review of the Current Understanding of Nanoparticles Protein Corona Composition. *Med. Pharm. Rep.* 2020, *93*, 342–350.

60. Capriotti, A.L.; Caracciolo, G.; Cavaliere, C.; Colapicchioni, V.; Piovesana, S.; Pozzi, D.; Laganà, A. Analytical Methods for Characterizing the Nanoparticle–Protein Corona. *Chromatographia* 2014, *77*, 755–769.

61. Caracciolo, G.; Safavi-Sohi, R.; Malekzadeh, R.; Poustchi, H.; Vasighi, M.; Chiozzi, R.Z.; Capriotti, A.L.; Laganà, A.; Hajipour, M.; Domenico, M.D.; et al. Disease-Specific Protein Corona Sensor

Arrays May Have Disease Detection Capacity. *Nanoscale Horiz.* 2019, *4*, 1063–1076.

62. Lu, X.; Xu, P.; Ding, H.-M.; Yu, Y.-S.; Huo, D.; Ma, Y.-Q. Tailoring the Component of Protein Corona via Simple Chemistry. *Nat. Commun.* 2019, *10*, 4520.

63. Farshbaf, M.; Valizadeh, H.; Panahi, Y.; Fatahi, Y.; Chen, M.; Zarebkohan, A.; Gao, H. The Impact of Protein Corona on the Biological Behavior of Targeting Nanomedicines. *Int. J. Pharm.* 2022, *614*, 121458.

64. Lazarovits, J.; Chen, Y.Y.; Sykes, E.A.; Chan, W.C. Nanoparticle–Blood Interactions: The Implications on Solid Tumour Targeting. *Chem. Commun.* 2015, *51*, 2756–2767.

65. Tomak, A.; Cesmeli, S.; Hanoglu, B.D.; Winkler, D.; Oksel Karakus, C. Nanoparticle-Protein Corona Complex: Understanding Multiple Interactions between Environmental Factors, Corona Formation, and Biological Activity. *Nanotoxicology* 2021, *15*, 1331–1357.

66. Zhou, Q.; Zhang, L.; Yang, T.; Wu, H. Stimuli-Responsive Polymeric Micelles for Drug Delivery and Cancer Therapy. *Int. J. Nanomed.* 2018, *13*, 2921.

67. Ragelle, H.; Crauste-Manciet, S.; Seguin, J.; Brossard, D.; Scherman, D.; Arnaud, P.; Chabot, G.G. Nanoemulsion Formulation of Fisetin Improves Bioavailability and Antitumour Activity in Mice. *Int. J. Pharm.* 2012, *427*, 452–459.

68. Hu, C.-M.J.; Zhang, L. Nanoparticle-Based Combination Therapy toward Overcoming Drug Resistance in Cancer. *Biochem. Pharmacol.* 2012, *83*, 1104–1111.

69. Joint Authority for Päijät-Häme Social and Health Care. Superficial Basal Cell Cancer's Photodynamic Therapy: Comparing Three Photosensitizers: Hexylaminolevulinate and Aminolevulinic Acid Nano Emulsion Versus Methylaminolevulinate; Joint Authority for Päijät-Häme Social and Health Care: Bethesda, MD, USA, 2019.

70. Liang, C.; Yang, Y.; Ling, Y.; Huang, Y.; Li, T.; Li, X. Improved Therapeutic Effect of Folate-Decorated PLGA–PEG Nanoparticles for Endometrial Carcinoma. *Bioorganic Med. Chem.* 2011, *19*, 4057–4066.

71. Dhas, N.L.; Ige, P.P.; Kudarha, R.R. Design, Optimization and in-Vitro Study of Folic Acid Conjugated-Chitosan

Functionalized PLGA Nanoparticle for Delivery of Bicalutamide in Prostate Cancer. *Powder Technol.* 2015, *283*, 234–245.

72. Derivery, E.; Bartolami, E.; Matile, S.; Gonzalez-Gaitan, M. Efficient Delivery of Quantum Dots into the Cytosol of Cells Using Cell-Penetrating Poly(Disulfide)s. *J. Am. Chem. Soc.* 2017, *139*, 10172–10175.

73. Mangeolle, T.; Yakavets, I.; Lequeux, N.; Pons, T.; Bezdetnaya, L.; Marchal, F. The Targeting Ability of Fluorescent Quantum Dots to the Folate Receptor Rich Tumors. *Photodiagnosis Photodyn. Ther.* 2019, *26*, 150–156.

74. Korangath, P.; Barnett, J.D.; Sharma, A.; Henderson, E.T.; Stewart, J.; Yu, S.-H.; Kandala, S.K.; Yang, C.-T.; Caserto, J.S.; Hedayati, M.; et al. Nanoparticle Interactions with Immune Cells Dominate Tumor Retention and Induce T Cell–Mediated Tumor Suppression in Models of Breast Cancer. *Sci. Adv.* 2020, *6*, eaay1601.

75. Geppert, M.; Himly, M. Iron Oxide Nanoparticles in Bioimaging—An Immune Perspective. *Front. Immunol.* 2021, *12*, 688927.

76. Norouzi, M.; Yathindranath, V.; Thliveris, J.A.; Kopec, B.M.; Siahaan, T.J.; Miller, D.W. Doxorubicin-Loaded Iron Oxide Nanoparticles for Glioblastoma Therapy: A Combinational Approach for Enhanced Delivery of Nanoparticles. *Sci. Rep.* 2020, *10*, 11292.

77. Wen, Z.; Feng, Y.; Hu, Y.; Lian, L.; Huang, H.; Guo, L.; Chen, S.; Yang, Q.; Zhang, M.; Wan, L.; et al. Multiwalled Carbon Nanotubes Co-Delivering Sorafenib and Epidermal Growth Factor Receptor siRNA Enhanced Tumor-Suppressing Effect on Liver Cancer. *Aging* 2021, *13*, 1872–1882.

78. Peng, Z.; Han, X.; Li, S.; Al-Youbi, A.O.; Bashammakh, A.S.; El-Shahawi, M.S.; Leblanc, R.M. Carbon Dots: Biomacromolecule Interaction, Bioimaging and Nanomedicine. *Coord. Chem. Rev.* 2017, *343*, 256–277.

79. Godin, B.; Driessen, W.H.; Proneth, B.; Lee, S.-Y.; Srinivasan, S.; Rumbaut, R.; Arap, W.; Pasqualini, R.; Ferrari, M.; Decuzzi, P. 2—An Integrated Approach for the Rational Design of Nanovectors for Biomedical Imaging and Therapy. In *Advances in Genetics*; Pasqualini, R., Ed.; Tissue-Specific Vascular Endothelial Signals and Vector Targeting, Part B.;

Academic Press: Cambridge, MA, USA, 2010; Volume 69, pp. 31–64.

80. Saraf, S.; Jain, A.; Tiwari, A.; Verma, A.; Panda, P.K.; Jain, S.K. Advances in Liposomal Drug Delivery to Cancer: An Overview. *J. Drug Deliv. Sci. Technol.* 2020, *56*, 101549.

81. Zhou, Q.; Zhang, L.; Wu, H. Nanomaterials for Cancer Therapies. *Nanotechnol. Rev.* 2017, *6*, 473–496.

82. Mross, K.; Niemann, B.; Massing, U.; Drevs, J.; Unger, C.; Bhamra, R.; Swenson, C.E. Pharmacokinetics of Liposomal Doxorubicin (TLC-D99; Myocet) in Patients with Solid Tumors: An Open-Label, Single-Dose Study. *Cancer Chemother. Pharmacol.* 2004, *54*, 514–524.

83. Zhao, Y.; Ren, W.; Zhong, T.; Zhang, S.; Huang, D.; Guo, Y.; Yao, X.; Wang, C.; Zhang, W.-Q.; Zhang, X. Tumor-Specific pH-Responsive Peptide-Modified pH-Sensitive Liposomes Containing Doxorubicin for Enhancing Glioma Targeting and Anti-Tumor Activity. *J. Control. Release* 2016, *222*, 56–66.

84. Ren, L.; Chen, S.; Li, H.; Zhang, Z.; Zhong, J.; Liu, M.; Zhou, X. MRI-Guided Liposomes for Targeted Tandem Chemotherapy and Therapeutic Response Prediction. *Acta Biomater.* 2016, *35*, 260–268.

85. Kumar, V.; Garg, V.; Dureja, H. Nanoemulsion for Delivery of Anticancer Drugs. *Cancer Adv.* 2022, *5*, e22016.

86. Mohite, P.; Rajput, T.; Pandhare, R.; Sangale, A.; Singh, S.; Prajapati, B.G. Nanoemulsion in Management of Colorectal Cancer: Challenges and Future Prospects. *Nanomanufacturing* 2023, *3*, 139–166.

87. Sánchez-López, E.; Guerra, M.; Dias-Ferreira, J.; Lopez-Machado, A.; Ettcheto, M.; Cano, A.; Espina, M.; Camins, A.; Garcia, M.L.; Souto, E.B. Current Applications of Nanoemulsions in Cancer Therapeutics. *Nanomaterials* 2019, *9*, 821.

88. Maeda, H.; Wu, J.; Sawa, T.; Matsumura, Y.; Hori, K. Tumor Vascular Permeability and the EPR Effect in Macromolecular Therapeutics: A Review. *J. Control. Release* 2000, *65*, 271–284.

89. Kretzer, I.F.; Maria, D.A.; Guido, M.C.; Contente, T.C.; Maranhão, R.C. Simvastatin Increases the Antineoplastic Actions of Paclitaxel Carried in Lipid Nanoemulsions in Melanoma-Bearing Mice. *Int. J. Nanomed.* 2016, *11*, 885–904.

90. Superficial Basal Cell Cancer's Photodynamic Therapy: Comparing Three Photosensitizes: HAL and BF-200 ALA Versus MAL | Clinical Research Trial Listing (Basal Cell Carcinoma | Basal Cell Tumor | Photochemotherapy | Photosensitizing Agent) (NCT02367547). Available online: https://www.centerwatch.com/clinical-trials/listings/170166/neoplasms-basal-cellsuperficial-basal-cell-cancers/ (accessed on 16 October 2023).

91. Gref, R.; Minamitake, Y.; Peracchia, M.T.; Trubetskoy, V.; Torchilin, V.; Langer, R. Biodegradable Long-Circulating Polymeric Nanospheres. *Science* 1994, *263*, 1600–1603.

92. Alexis, F.; Pridgen, E.M.; Langer, R.; Farokhzad, O.C. Nanoparticle Technologies for Cancer Therapy. In *Drug Delivery*; Schäfer-Korting, M., Ed.; *Handbook of Experimental Pharmacology*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 55–86. ISBN 978-3-642-00477-3.

93. Parveen, S.; Sahoo, S.K. Polymeric Nanoparticles for Cancer Therapy. *J. Drug Target.* 2008, *16*, 108–123.

94. Vilos, C.; Morales, F.A.; Solar, P.A.; Herrera, N.S.; Gonzalez-Nilo, F.D.; Aguayo, D.A.; Mendoza, H.L.; Comer, J.; Bravo, M.L.; Gonzalez, P.A.; et al. Paclitaxel-PHBV Nanoparticles and Their Toxicity to Endometrial and Primary Ovarian Cancer Cells. *Biomaterials* 2013, *34*, 4098–4108.

95. Chittasupho, C.; Xie, S.-X.; Baoum, A.; Yakovleva, T.; Siahaan, T.J.; Berkland, C.J. ICAM-1 Targeting of Doxorubicin-Loaded PLGA Nanoparticles to Lung Epithelial Cells. *Eur. J. Pharm. Sci.* 2009, *37*, 141–150.

96. Zhang, C.; Zhao, L.; Dong, Y.; Zhang, X.; Lin, J.; Chen, Z. Folate-Mediated Poly(3-Hydroxybutyrate-Co-3-Hydroxyoctanoate) Nanoparticles for Targeting Drug Delivery. *Eur. J. Pharm. Biopharm.* 2010, *76*, 10–16.

97. Dhar, S.; Gu, F.X.; Langer, R.; Farokhzad, O.C.; Lippard, S.J. Targeted Delivery of Cisplatin to Prostate Cancer Cells by Aptamer Functionalized Pt(IV) Prodrug-PLGA–PEG Nanoparticles. *Proc. Natl. Acad. Sci. USA* 2008, *105*, 17356–17361.

98. Shah, M.; Ullah, N.; Choi, M.H.; Kim, M.O.; Yoon, S.C. Amorphous Amphiphilic P(3HV-Co-4HB)-b-mPEG

Block Copolymer Synthesized from Bacterial Copolyester via Melt Transesterification: Nanoparticle Preparation, Cisplatin-Loading for Cancer Therapy and in Vitro Evaluation. *Eur. J. Pharm. Biopharm.* 2012, *80*, 518–527.

99. Masood, F. Polymeric Nanoparticles for Targeted Drug Delivery System for Cancer Therapy. *Mater. Sci. Eng. C* 2016, *60*, 569–578.

100. Ambruosi, A.; Khalansky, A.S.; Yamamoto, H.; Gelperina, S.E.; Begley, D.J.; Kreuter, J. Biodistribution of Polysorbate 80-Coated Doxorubicin-Loaded [14C]-Poly(Butyl Cyanoacrylate) Nanoparticles after Intravenous Administration to Glioblastoma-Bearing Rats. *J. Drug Target.* 2006, *14*, 97–105.

101. Ramge, P.; Unger, R.E.; Oltrogge, J.B.; Zenker, D.; Begley, D.; Kreuter, J.; Von Briesen, H. Polysorbate-80 Coating Enhances Uptake of Polybutylcyanoacrylate (PBCA)-Nanoparticles by Human and Bovine Primary Brain Capillary Endothelial Cells. *Eur. J. Neurosci.* 2000, *12*, 1931–1940.

102. Jain, A.; Jain, A.; Garg, N.K.; Tyagi, R.K.; Singh, B.; Katare, O.P.; Webster, T.J.; Soni, V. Surface Engineered Polymeric Nanocarriers Mediate the Delivery of Transferrin–Methotrexate Conjugates for an Improved Understanding of Brain Cancer. *Acta Biomater.* 2015, *24*, 140–151.

103. Shen, X.; Dirisala, A.; Toyoda, M.; Xiao, Y.; Guo, H.; Honda, Y.; Nomoto, T.; Takemoto, H.; Miura, Y.; Nishiyama, N. pH-Responsive Polyzwitterion Covered Nanocarriers for DNA Delivery. *J. Control. Release* 2023, *360*, 928–939.

104. Dirisala, A.; Osada, K.; Chen, Q.; Tockary, T.A.; Machitani, K.; Osawa, S.; Liu, X.; Ishii, T.; Miyata, K.; Oba, M. Optimized Rod Length of Polyplex Micelles for Maximizing Transfection Efficiency and Their Performance in Systemic Gene Therapy against Stroma-Rich Pancreatic Tumors. *Biomaterials* 2014, *35*, 5359–5368.

105. Zhou, Q.; Li, J.; Xiang, J.; Shao, S.; Zhou, Z.; Tang, J.; Shen, Y. Transcytosis-Enabled Active Extravasation of Tumor Nanomedicine. *Adv. Drug Deliv. Rev.* 2022, *189*, 114480.

106. Sindhwani, S.; Syed, A.M.; Ngai, J.; Kingston, B.R.; Maiorino, L.; Rothschild, J.; MacMillan, P.; Zhang, Y.; Rajesh, N.U.; Hoang, T. The Entry of

Nanoparticles into Solid Tumours. *Nat. Mater.* 2020, *19*, 566–575.

107. Yang, T.; Zelikin, A.N.; Chandrawati, R. Progress and Promise of Nitric Oxide-Releasing Platforms. *Adv. Sci.* 2018, *5*, 1701043.

108. Chen, H.-T.; Neerman, M.F.; Parrish, A.R.; Simanek, E.E. Cytotoxicity, Hemolysis, and Acute in Vivo Toxicity of Dendrimers Based on Melamine, Candidate Vehicles for Drug Delivery. *J. Am. Chem. Soc.* 2004, *126*, 10044–10048.

109. Dirheimer, L.; Pons, T.; Marchal, F.; Bezdetnaya, L. Quantum Dots Mediated Imaging and Phototherapy in Cancer Spheroid Models: State of the Art and Perspectives. *Pharmaceutics* 2022, *14*, 2136.

110. Granadeiro, C.M.; Ferreira, R.A.; Soares-Santos, P.C.; Carlos, L.D.; Trindade, T.; Nogueira, H.I. Lanthanopolyoxotungstates in Silica Nanoparticles: Multi-Wavelength Photoluminescent Core/Shell Materials. *J. Mater. Chem.* 2010, *20*, 3313–3318.

111. Peng, C.-W.; Li, Y. Application of Quantum Dots-Based Biotechnology in Cancer Diagnosis: Current Status and Future Perspectives. *J. Nanomater.* 2010, *2010*, e676839.

112. Shukla, R.; Bansal, V.; Chaudhary, M.; Basu, A.; Bhonde, R.R.; Sastry, M. Biocompatibility of Gold Nanoparticles and Their Endocytotic Fate inside the Cellular Compartment: A Microscopic Overview. *Langmuir* 2005, *21*, 10644–10654.

113. Zhou, W.; Gao, X.; Liu, D.; Chen, X. Gold Nanoparticles for in Vitro Diagnostics. *Chem. Rev.* 2015, *115*, 10575–10636.

114. Amendola, V.; Pilot, R.; Frasconi, M.; Maragò, O.M.; Iatì, M.A. Surface Plasmon Resonance in Gold Nanoparticles: A Review. *J. Phys. Condens. Matter* 2017, *29*, 203002.

115. Jain, P.K.; Lee, K.S.; El-Sayed, I.H.; El-Sayed, M.A. Calculated Absorption and Scattering Properties of Gold Nanoparticles of Different Size, Shape, and Composition: Applications in Biological Imaging and Biomedicine. *J. Phys. Chem. B* 2006, *110*, 7238–7248.

116. Ali, M.R.K.; Wu, Y.; El-Sayed, M.A. Gold-Nanoparticle-Assisted Plasmonic Photothermal Therapy Advances Toward

Clinical Application. *J. Phys. Chem. C* 2019, *123*, 15375–15393.

117. Lane, L.A.; Xue, R.; Nie, S. Emergence of Two Near-Infrared Windows for In Vivo and Intraoperative SERS. *Curr. Opin. Chem. Biol.* 2018, *45*, 95–103.

118. Liao, S.; Yue, W.; Cai, S.; Tang, Q.; Lu, W.; Huang, L.; Qi, T.; Liao, J. Improvement of Gold Nanorods in Photothermal Therapy: Recent Progress and Perspective. *Front. Pharmacol.* 2021, *12*, 664123.

119. Gomes, M.C.; Chen, J.; Cunha, A.; Trindade, T.; Zheng, G.; Tomé, J.P.C. Complex Cellular Environments Imaged by SERS Nanoprobes Using Sugars as an All-in-One Vector. *J. Mater. Chem. B* 2021, *9*, 9285–9294.

120. Kesharwani, P.; Ma, R.; Sang, L.; Fatima, M.; Sheikh, A.; Abourehab, M.A.S.; Gupta, N.; Chen, Z.-S.; Zhou, Y. Gold Nanoparticles and Gold Nanorods in the Landscape of Cancer Therapy. *Mol. Cancer* 2023, *22*, 98.

121. Abadeer, N.S.; Murphy, C.J. Recent Progress in Cancer Thermal Therapy Using Gold Nanoparticles. *J. Phys. Chem. C* 2016, *120*, 4691–4716.

122. Sztandera, K.; Gorzkiewicz, M.; Klajnert-Maculewicz, B. Gold Nanoparticles in Cancer Treatment. *Mol. Pharm.* 2019, *16*, 1–23.

123. Kong, T.; Zeng, J.; Wang, X.; Yang, X.; Yang, J.; McQuarrie, S.; McEwan, A.; Roa, W.; Chen, J.; Xing, J.Z. Enhancement of Radiation Cytotoxicity in Breast-Cancer Cells by Localized Attachment of Gold Nanoparticles. *Small* 2008, *4*, 1537–1543.

124. Nabavinia, M.; Beltran-Huarac, J. Recent Progress in Iron Oxide Nanoparticles as Therapeutic Magnetic Agents for Cancer Treatment and Tissue Engineering. *ACS Appl. Bio Mater.* 2020, *3*, 8172–8187.

125. Hosseinkazemi, H.; Samani, S.; O'Neill, A.; Soezi, M.; Moghoofei, M.; Azhdari, M.H.; Aavani, F.; Nazbar, A.; Keshel, S.H.; Doroudian, M. Applications of Iron Oxide Nanoparticles against Breast Cancer. *J. Nanomater.* 2022, *2022*, 6493458.

126. Soetaert, F.; Korangath, P.; Serantes, D.; Fiering, S.; Ivkov, R. Cancer Therapy with Iron Oxide Nanoparticles: Agents of Thermal and Immune Therapies. *Adv. Drug Deliv. Rev.* 2020, *163–164*, 65–83.

127. Han, C.; Zhang, A.; Kong, Y.; Yu, N.; Xie, T.; Dou, B.; Li, K.; Wang, Y.; Li, J.; Xu, K. Multifunctional Iron Oxide-Carbon Hybrid Nanoparticles for Targeted Fluorescent/MR Dual-Modal Imaging and Detection of Breast Cancer Cells. *Anal. Chim. Acta* 2019, *1067*, 115–128.

128. Deng, S.; Zhang, W.; Zhang, B.; Hong, R.; Chen, Q.; Dong, J.; Chen, Y.; Chen, Z.; Wu, Y. Radiolabeled Cyclic Arginine-Glycine-Aspartic (RGD)-Conjugated Iron Oxide Nanoparticles as Single-Photon Emission Computed Tomography (SPECT) and Magnetic Resonance Imaging (MRI) Dual-Modality Agents for Imaging of Breast Cancer. *J. Nanopart Res.* 2015, *17*, 19.

129. Das, P.; Salvioni, L.; Malatesta, M.; Vurro, F.; Mannucci, S.; Gerosa, M.; Antonietta Rizzuto, M.; Tullio, C.; Degrassi, A.; Colombo, M.; et al. Colloidal Polymer-Coated Zn-Doped Iron Oxide Nanoparticles with High Relaxivity and Specific Absorption Rate for Efficient Magnetic Resonance Imaging and Magnetic Hyperthermia. *J. Colloid Interface Sci.* 2020, *579*, 186–194.

130. Nascimento, C.S.; Alves, É.A.R.; de Melo, C.P.; Corrêa-Oliveira, R.; Calzavara-Silva, C.E. Immunotherapy for Cancer: Effects of Iron Oxide Nanoparticles on Polarization of Tumor-Associated Macrophages. *Nanomedicine* 2021, *16*, 2633–2650.

131. Zanganeh, S.; Hutter, G.; Spitler, R.; Lenkov, O.; Mahmoudi, M.; Shaw, A.; Pajarinen, J.S.; Nejadnik, H.; Goodman, S.; Moseley, M.; et al. Iron Oxide Nanoparticles Inhibit Tumour Growth by Inducing Pro-Inflammatory Macrophage Polarization in Tumour Tissues. *Nat. Nanotechnol.* 2016, *11*, 986–994.

132. Pandey, R.; Yang, F.-S.; Sivasankaran, V.P.; Lo, Y.-L.; Wu, Y.-T.; Chang, C.-Y.; Chiu, C.-C.; Liao, Z.-X.; Wang, L.-F. Comparing the Variants of Iron Oxide Nanoparticle-Mediated Delivery of miRNA34a for Efficiency in Silencing of PD-L1 Genes in Cancer Cells. *Pharmaceutics* 2023, *15*, 215.

133. Yang, Z.; Duan, J.; Wang, J.; Liu, Q.; Shang, R.; Yang, X.; Lu, P.; Xia, C.; Wang, L.; Dou, K. Superparamagnetic Iron Oxide Nanoparticles Modified with Polyethylenimine and Galactose for siRNA Targeted Delivery in Hepatocellular Carcinoma Therapy. *Int. J. Nanomed.* 2018, *13*, 1851–1865.

134. Hosnedlova, B.; Kepinska, M.; Fernandez, C.; Peng, Q.; Ruttkay-Nedecky, B.; Milnerowicz, H.; Kizek, R. Carbon Nanomaterials for Targeted Cancer Therapy Drugs: A Critical Review. *Chem. Rec.* 2019, *19*, 502–522.

135. Tang, L.; Li, J.; Pan, T.; Yin, Y.; Mei, Y.; Xiao, Q.; Wang, R.; Yan, Z.; Wang, W. Versatile Carbon Nanoplatforms for Cancer Treatment and Diagnosis: Strategies, Applications and Future Perspectives. *Theranostics* 2022, *12*, 2290–2321.

136. Roy, H.; Bhanja, S.; Panigrahy, U.P.; Theendra, V.K. Chapter 4—Graphene-Based Nanovehicles for Drug Delivery. In *Characterization and Biology of Nanomaterials for Drug Delivery*; Mohapatra, S.S., Ranjan, S., Dasgupta, N., Mishra, R.K., Thomas, S., Eds.; *Micro and NanoTechnologies*; Elsevier: Amsterdam, The Netherlands, 2019; pp. 77–111. ISBN 978-0-12-814031-4.

137. Jampilek, J.; Kralova, K. Advances in Drug Delivery Nanosystems Using Graphene-Based Materials and Carbon Nanotubes. *Materials* 2021, *14*, 1059.

138. Patel, S.C.; Lee, S.; Lalwani, G.; Suhrland, C.; Chowdhury, S.M.; Sitharaman, B. Graphene-Based Platforms for Cancer Therapeutics. *Ther. Deliv.* 2016, *7*, 101–116.

139. Monteiro, A.R.; Neves, M.G.P.M.S.; Trindade, T. Functionalization of Graphene Oxide with Porphyrins: Synthetic Routes and Biological Applications. *ChemPlusChem* 2020, *85*, 1857–1880.

140. Zhang, L.; Xia, J.; Zhao, Q.; Liu, L.; Zhang, Z. Functional Graphene Oxide as a Nanocarrier for Controlled Loading and Targeted Delivery of Mixed Anticancer Drugs. *Small* 2010, *6*, 537–544.

141. Abdelsayed, V.; Moussa, S.; Hassan, H.M.; Aluri, H.S.; Collinson, M.M.; El-Shall, M.S. Photothermal Deoxygenation of Graphite Oxide with Laser Excitation in Solution and Graphene-Aided Increase in Water Temperature. *J. Phys. Chem. Lett.* 2010, *1*, 2804–2809.

142. Lu, X.; Yang, L.; Yang, Z. Photothermal Sensing of Nano-Devices Made of Graphene Materials. *Sensors* 2020, *20*, 3671.

143. Tang, L.; Xiao, Q.; Mei, Y.; He, S.; Zhang, Z.; Wang, R.; Wang, W. Insights on Functionalized Carbon Nanotubes for

Cancer Theranostics. *J. Nanobiotechnol.* 2021, *19*, 423.

144. Oh, Y.; Jin, J.-O.; Oh, J. Photothermal-Triggered Control of Sub-Cellular Drug Accumulation Using Doxorubicin-Loaded Single-Walled Carbon Nanotubes for the Effective Killing of Human Breast Cancer Cells. *Nanotechnology* 2017, *28*, 125101.

145. Yoong, S.L.; Wong, B.S.; Zhou, Q.L.; Chin, C.F.; Li, J.; Venkatesan, T.; Ho, H.K.; Yu, V.; Ang, W.H.; Pastorin, G. Enhanced Cytotoxicity to Cancer Cells by Mitochondria-Targeting MWCNTs Containing Platinum(IV) Prodrug of Cisplatin. *Biomaterials* 2014, *35*, 748–759.

146. Acquah, S.F.; Penkova, A.V.; Markelov, D.A.; Semisalova, A.S.; Leonhardt, B.E.; Magi, J.M. The Beautiful Molecule: 30 Years of C60 and Its Derivatives. *ECS J. Solid State Sci. Technol.* 2017, *6*, M3155.

147. Chen, Z.; Ma, L.; Liu, Y.; Chen, C. Applications of Functionalized Fullerenes in Tumor Theranostics. *Theranostics* 2012, *2*, 238–250.

148. Goh, E.J.; Kim, K.S.; Kim, Y.R.; Jung, H.S.; Beack, S.; Kong, W.H.; Scarcelli, G.; Yun, S.H.; Hahn, S.K. Bioimaging of Hyaluronic Acid Derivatives Using Nanosized Carbon Dots. *Biomacromolecules* 2012, *13*, 2554–2561.

149. Lei, D.; Yang, W.; Gong, Y.; Jing, J.; Nie, H.; Yu, B.; Zhang, X. Non-Covalent Decoration of Carbon Dots with Folic Acid via a Polymer-Assisted Strategy for Fast and Targeted Cancer Cell Fluorescence Imaging. *Sens. Actuators B Chem.* 2016, *230*, 714–720.

150. Li, Q.; Ohulchanskyy, T.Y.; Liu, R.; Koynov, K.; Wu, D.; Best, A.; Kumar, R.; Bonoiu, A.; Prasad, P.N. Photoluminescent Carbon Dots as Biocompatible Nanoprobes for Targeting Cancer Cells In Vitro. *J. Phys. Chem. C* 2010, *114*, 12062–12068.

151. Calabrese, G.; De Luca, G.; Nocito, G.; Rizzo, M.G.; Lombardo, S.P.; Chisari, G.; Forte, S.; Sciuto, E.L.; Conoci, S. Carbon Dots: An Innovative Tool for Drug Delivery in Brain Tumors. *Int. J. Mol. Sci.* 2021, *22*, 11783.

152. Zeng, Q.; Shao, D.; He, X.; Ren, Z.; Ji, W.; Shan, C.; Qu, S.; Li, J.; Chen, L.; Li, Q. Carbon Dots as a Trackable Drug Delivery Carrier for Localized Cancer Therapy In Vivo. *J. Mater. Chem. B* 2016, *4*, 5119–5126.

153. Liu, W.; Speranza, G. Functionalization of Carbon Nanomaterials for Biomedical Applications. *C* 2019, *5*, 72.

154. Landen, C.N.; Kinch, M.S.; Sood, A.K. EphA2 as a Target for Ovarian Cancer Therapy. *Expert Opin. Ther. Targets* 2005, *9*, 1179–1187.

155. Hamishehkar, H.; Bahadori, M.B.; Vandghanooni, S.; Eskandani, M.; Nakhlband, A.; Eskandani, M. Preparation, Characterization and Anti-Proliferative Effects of Sclareol-Loaded Solid Lipid Nanoparticles on A549 Human Lung Epithelial Cancer Cells. *J. Drug Deliv. Sci. Technol.* 2018, *45*, 272–280.

156. Tajbakhsh, A.; Hasanzadeh, M.; Rezaee, M.; Khedri, M.; Khazaei, M.; ShahidSales, S.; Ferns, G.A.; Hassanian, S.M.; Avan, A. Therapeutic Potential of Novel Formulated Forms of Curcumin in the Treatment of Breast Cancer by the Targeting of Cellular and Physiological Dysregulated Pathways. *J. Cell. Physiol.* 2018, *233*, 2183–2192.

157. Guorgui, J.; Wang, R.; Mattheolabakis, G.; Mackenzie, G.G. Curcumin Formulated in Solid Lipid Nanoparticles Has Enhanced Efficacy in Hodgkin's Lymphoma in Mice. *Arch. Biochem. Biophys.* 2018, *648*, 12–19.

158. Clemente, N.; Ferrara, B.; Gigliotti, C.L.; Boggio, E.; Capucchio, M.T.; Biasibetti, E.; Schiffer, D.; Mellai, M.; Annovazzi, L.; Cangemi, L. Solid Lipid Nanoparticles Carrying Temozolomide for Melanoma Treatment. Preliminary In Vitro and In Vivo Studies. *Int. J. Mol. Sci.* 2018, *19*, 255.

159. Clemons, T.D.; Singh, R.; Sorolla, A.; Chaudhari, N.; Hubbard, A.; Iyer, K.S. Distinction Between Active and Passive Targeting of Nanoparticles Dictate Their Overall Therapeutic Efficacy. *Langmuir* 2018, *34*, 15343–15349.

160. Attia, M.F.; Anton, N.; Wallyn, J.; Omran, Z.; Vandamme, T.F. An Overview of Active and Passive Targeting Strategies to Improve the Nanocarriers Efficiency to Tumour Sites. *J. Pharm. Pharmacol.* 2019, *71*, 1185–1198.

161. Kobayashi, H.; Watanabe, R.; Choyke, P.L. Improving Conventional Enhanced Permeability and Retention (EPR) Effects; What Is the Appropriate Target? *Theranostics* 2014, *4*, 81.

162. Wang, J.; Tian, S.; Petros, R.A.; Napier, M.E.; DeSimone, J.M. The Complex Role of Multivalency in Nanoparticles Targeting the Transferrin Receptor for

Cancer Therapies. *J. Am. Chem. Soc.* 2010, *132*, 11306–11313.

163. Harris, J.M.; Chess, R.B. Effect of Pegylation on Pharmaceuticals. *Nat. Rev. Drug Discov.* 2003, *2*, 214–221.

164. Valencia, S.; Vargas, X.; Rios, L.; Restrepo, G.; Marín, J.M. Sol–Gel and Low-Temperature Solvothermal Synthesis of Photoactive Nano-Titanium Dioxide. *J. Photochem. Photobiol. A Chem.* 2013, *251*, 175–181.

165. Gref, R.; Lück, M.; Quellec, P.; Marchand, M.; Dellacherie, E.; Harnisch, S.; Blunk, T.; Müller, R.H. 'Stealth' Corona-Core Nanoparticles Surface Modified by Polyethylene Glycol (PEG): Influences of the Corona (PEG Chain Length and Surface Density) and of the Core Composition on Phagocytic Uptake and Plasma Protein Adsorption. *Colloids Surf. B Biointerfaces* 2000, *18*, 301–313.

166. Yang, X.; Li, Y.; Li, M.; Zhang, L.; Feng, L.; Zhang, N. Hyaluronic Acid-Coated Nanostructured Lipid Carriers for Targeting Paclitaxel to Cancer. *Cancer Lett.* 2013, *334*, 338–345.

167. Neves, A.R.; Queiroz, J.F.; Reis, S. Brain-Targeted Delivery of Resveratrol Using Solid Lipid Nanoparticles Functionalized with Apolipoprotein E. *J. Nanobiotechnol.* 2016, *14*, 27.

168. Liu, B.; Han, L.; Liu, J.; Han, S.; Chen, Z.; Jiang, L. Co-Delivery of Paclitaxel and TOS-Cisplatin via TAT-Targeted Solid Lipid Nanoparticles with Synergistic Antitumor Activity against Cervical Cancer. *IJN* 2017, *12*, 955–968.

169. Ahmed, N.; Fessi, H.; Elaissari, A. Theranostic Applications of Nanoparticles in Cancer. *Drug Discov. Today* 2012, *17*, 928–934.

170. Zhao, C.-Y.; Cheng, R.; Yang, Z.; Tian, Z.-M. Nanotechnology for Cancer Therapy Based on Chemotherapy. *Molecules* 2018, *23*, 826.

171. Figueiredo, P.; Bauleth-Ramos, T.; Hirvonen, J.; Sarmento, B.; Santos, H.A. Chapter 1—The Emerging Role of Multifunctional Theranostic Materials in Cancer Nanomedicine. In *Handbook of Nanomaterials for Cancer Theranostics*; Conde, J., Ed.; Elsevier: Amsterdam, The Netherlands, 2018; pp. 1–31. ISBN 978-0-12-813339-2.

172. Zhu, L.; Yang, L.; Zhou, Z. Nanomaterials in Cancer Theranostics. In *Bioactivity of Engineered Nanoparticles*; Yan, B., Zhou, H., Gardea-Torresdey, J.L.,

Eds.; *Nanomedicine and Nanotoxicology*; Springer: Singapore, 2017; pp. 173–206. ISBN 978-981-10-5864-6.

173. Panda, S.; Hajra, S.; Kaushik, A.; Rubahn, H.G.; Mishra, Y.K.; Kim, H.J. Smart Nanomaterials as the Foundation of a Combination Approach for Efficient Cancer Theranostics. *Mater. Today Chem.* 2022, *26*, 101182.

174. Anani, T.; Rahmati, S.; Sultana, N.; David, A.E. MRI-Traceable Theranostic Nanoparticles for Targeted Cancer Treatment. *Theranostics* 2021, *11*, 579–601.

175. Wang, K.; An, L.; Tian, Q.; Lin, J.; Yang, S. Gadolinium-Labelled Iron/Iron Oxide Core/Shell Nanoparticles as T1–T2 Contrast Agent for Magnetic Resonance Imaging. *RSC Adv.* 2018, *8*, 26764–26770.