



Metal-Organic Frameworks for Targeted Cancer Drug Delivery: A Systematic Review of Stimuli-Responsive Platforms and Therapeutic Performance

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ABSTRACT

Metal-Organic Frameworks (MOFs) have gained increasing attention as promising nanocarriers for targeted cancer drug delivery due to their high surface area, tunable porosity, adjustable chemical structure, and capacity for controlled drug release. Conventional chemotherapy often faces limitations such as systemic toxicity, poor tumor selectivity, low bioavailability, and damage to healthy tissues. Stimuli-responsive MOFs enable drug release in response to specific tumor microenvironment conditions, including acidic pH, redox imbalance, enzyme overexpression, hypoxia, or external triggers such as light and temperature. This systematic review synthesizes 30 selected studies, focusing on MOF types, therapeutic cargo, stimuli-responsive mechanisms, cancer models, and reported therapeutic outcomes. Findings show that ZIF-8, UiO-66, MIL-series, and related MOF platforms are widely investigated, with doxorubicin and other anticancer drugs frequently used. pH-responsive and redox-responsive systems dominate, while multifunctional MOFs combining chemotherapy with photothermal or photodynamic therapy show strong potential. Clinical translation remains limited due to unresolved concerns regarding long-term biosafety, biodegradation, pharmacokinetics, immune response, reproducibility, and scalability. Stimuli-responsive MOFs represent a promising direction for precision cancer therapy, but further *in vivo* validation and translational studies are required.

Keywords: MOFs; targeted drug delivery; cancer therapy; controlled release; nanomedicine

I. INTRODUCTION

Cancer remains one of the most serious global health problems and continues to create a high burden for patients, health systems, and society. Global cancer data show that approximately 20 million new cancer cases and 9.7 million cancer-related deaths occurred in 2022, indicating the urgent need for more effective and safer therapeutic strategies (Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, 2018). Although chemotherapy remains one of the main approaches in cancer treatment, its clinical use is still limited by poor selectivity, systemic toxicity, low bioavailability, multidrug resistance, and damage to normal tissues. These limitations show that cancer therapy requires drug delivery systems that can improve tumor targeting, regulate drug release, and reduce adverse effects. Targeted drug delivery has become an important strategy in modern oncology because it aims to increase drug accumulation in tumor tissues while minimizing exposure to healthy cells. In this context,

nanocarrier-based systems have gained significant attention because they can improve drug solubility, protect therapeutic agents from premature degradation, and enhance controlled release. Among various nanocarrier platforms, Metal-Organic Frameworks (MOFs) have emerged as promising candidates for cancer drug delivery due to their unique structural and chemical characteristics. MOFs are porous crystalline materials composed of metal ions or metal clusters coordinated with organic linkers. Their high surface area, tunable pore size, adjustable framework structure, and modifiable surface chemistry make them suitable for loading and delivering different anticancer agents (Feng et al., 2025).

MOFs have several advantages over conventional drug delivery carriers (Bui et al., 2022; Chen et al., 2024; Gu et al., 2024; Saleem et al., 2024)(Aliyu M. Hamisu, Azhar Ariffin, Arief C. Wibowo, 2020; Aliyu M. Hamisu, Azhar Ariffin, 2020; Coluccia et al., 2022; Jiang et al., 2024). Their porous structures allow high drug-loading capacity, while their flexible chemistry enables functionalization with targeting ligands, imaging agents, polymers, or therapeutic molecules. MOFs can also be designed to improve biocompatibility, biodegradability, and controlled release performance. Commonly studied MOF platforms, such as ZIF-8, UiO-66, MIL-series, and HKUST-based structures, have been explored for delivering anticancer drugs including doxorubicin, cisplatin, paclitaxel, curcumin, and other therapeutic compounds (Vaishali M. Patil, Satya P. Gupta, Neeraj Masand, Krishnan Balasubramanian, 2024). These developments indicate that MOFs are not only passive carriers, but also engineered therapeutic platforms that can support more precise cancer treatment. A major strength of MOF-based drug delivery lies in their stimuli-responsive behavior. Tumor tissues have distinct microenvironmental characteristics, including acidic pH, elevated glutathione concentration, enzyme overexpression, hypoxia, and abnormal metabolic activity. MOFs can be engineered to respond to these internal stimuli and release drugs more selectively within tumor sites. In addition, external stimuli such as light, temperature, magnetic fields, and ultrasound can also be used to trigger drug release or activate combination therapy. This responsiveness allows MOF-based platforms to support controlled release, tumor-specific delivery, and improved therapeutic performance (Vaishali M. Patil, Satya P. Gupta, Neeraj Masand, Krishnan Balasubramanian, 2024).

Recent studies have also shown that MOFs can support multifunctional cancer treatment. Beyond single-drug chemotherapy, MOFs can be designed for combined therapeutic strategies, including chemo-photothermal therapy, chemo-photodynamic therapy, immunotherapy support, gene delivery, and theranostic applications. These multifunctional features are important because cancer treatment often requires more than one therapeutic mechanism to improve treatment response and overcome resistance. Therefore, the development of stimuli-responsive MOFs reflects a broader movement from conventional drug carriers toward smart nanomedicine platforms for precision oncology (Yu et al., 2026). Despite these promising developments, MOF-based cancer drug delivery still faces several challenges. Many studies report strong *in vitro* results, but fewer provide robust *in vivo* validation and clinical translation evidence. Key issues such as long-term toxicity, biodegradation pathways, immune response, pharmacokinetics, reproducibility, large-scale synthesis, and regulatory safety remain unresolved. These limitations indicate that the success of MOF-based drug delivery should not be measured only by drug-loading capacity or release efficiency. A clinically meaningful MOF platform must also show biological safety, tumor selectivity, therapeutic superiority, stability, scalability, and translational feasibility (Liu et al., 2026).

The present systematic review is designed to address this research gap by examining Metal-Organic Frameworks for targeted cancer drug delivery, with specific attention to stimuli-responsive platforms and therapeutic performance. Based on the screening and thematic mapping of selected studies, current research shows strong attention to drug delivery, cancer

therapy, controlled release, pH-responsive systems, ZIF-8, UiO-66, doxorubicin, nanoparticles, and targeted delivery. This pattern confirms that the field has shifted from basic material synthesis toward functional and biologically responsive cancer nanomedicine platforms. Accordingly, this review aims to synthesize current evidence on the structural design, stimuli-responsive mechanisms, and therapeutic outcomes of MOF-based cancer drug delivery systems. The core argument of this review is that MOFs have significant potential as targeted cancer therapeutic platforms because their tunable structures and responsive release properties can improve drug selectivity, reduce systemic toxicity, and enhance anticancer efficacy. By integrating material design, biological responsiveness, and therapeutic performance, this review provides a systematic understanding of current progress, research limitations, and future directions for clinically relevant MOF-based cancer drug delivery systems.

II. METHODS

II.1 Study Design

This study used a systematic literature review approach to examine the development of Metal-Organic Frameworks (MOFs) as stimuli-responsive platforms for targeted cancer drug delivery. The review was conducted by following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guideline to ensure a transparent, systematic, and reproducible process in article identification, screening, eligibility assessment, and final inclusion. The review focused on three main aspects: MOF-based platform design, stimuli-responsive drug release mechanisms, and therapeutic performance in cancer treatment (Abdollah Karami, Omnia Mohamed, Ahmed Ahmed, Ghaleb A Husseini, 2021).

II.2 Data Sources and Search Strategy

The literature search was conducted using the Scopus database. Scopus was selected because it provides broad coverage of peer-reviewed scientific publications in chemistry, pharmaceutical sciences, nanomedicine, biomaterials, and biomedical engineering. The search covered articles published between 2010 and 2026. The keywords used in the search included “Metal-Organic Framework,” “MOF,” “drug delivery,” “cancer therapy,” “targeted delivery,” “stimuli-responsive,” “pH-responsive,” “controlled release,” “nanocarrier,” and “therapeutic performance.” These keywords were combined using Boolean operators to obtain articles relevant to MOF-based targeted cancer drug delivery.

II.3 Inclusion and Exclusion Criteria

The inclusion criteria were: articles discussing MOFs as drug delivery systems for cancer therapy; studies involving stimuli-responsive mechanisms such as pH, redox, enzyme, light, temperature, or magnetic response; studies reporting drug-loading, release behavior, cytotoxicity, tumor-targeting ability, or therapeutic performance; peer-reviewed journal articles; and articles written in English. The exclusion criteria were: studies unrelated to cancer therapy; studies using MOFs only for non-biomedical purposes such as gas storage, adsorption, or catalysis; articles without discussion of drug delivery or therapeutic performance; conference papers, editorials, letters, and non-peer-reviewed publications.

II.4 Screening and Selection Process

The article selection process followed four PRISMA stages: identification, screening, eligibility, and inclusion. The initial search identified records from the Scopus database. Duplicate records and irrelevant articles were removed during the screening stage. Articles were then assessed based on title, abstract, and full-text relevance. The final number of selected

articles was determined based on their direct relevance to MOF-based targeted cancer drug delivery and stimuli-responsive therapeutic performance. The screening process is presented in the PRISMA flow diagram in Figure 1. The document also shows that the final review focused on selected studies related to MOF-based drug delivery, with dominant thematic keywords such as drug delivery, cancer therapy, controlled release, pH-responsive systems, ZIF-8, UiO-66, doxorubicin, nanoparticles, and targeted delivery.

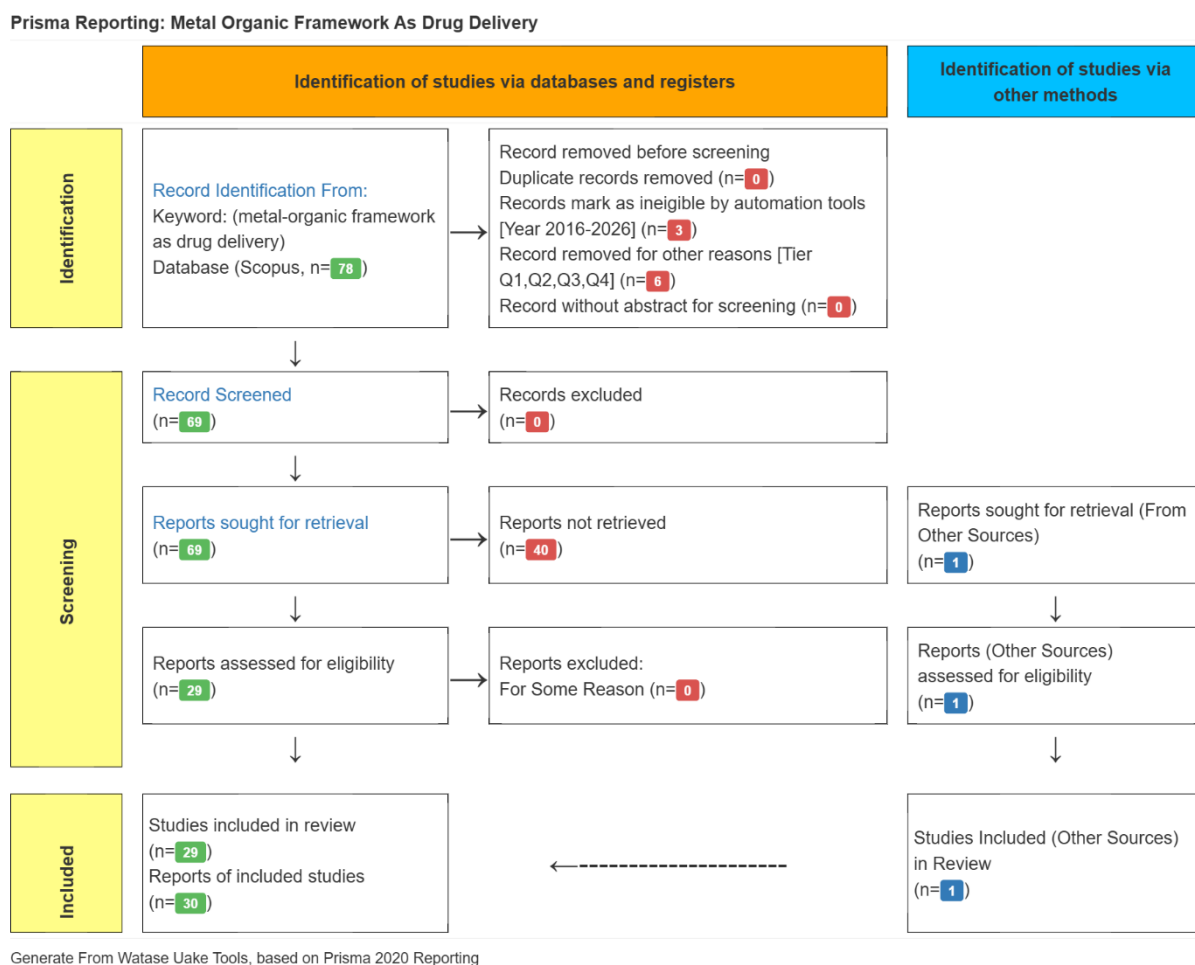


Figure 1. Prisma flow diagram of the Article Screening and Selection Process

II.5 Data Extraction

Data were extracted systematically from each selected article. The extracted information included author name, year of publication, MOF type or platform, drug or therapeutic cargo, stimuli-responsive mechanism, cancer type or model, experimental approach, and key therapeutic findings. Particular attention was given to drug-loading capacity, release profile, tumor selectivity, cytotoxicity against cancer cells, biocompatibility toward normal cells, and in vivo therapeutic performance where available.

II.6 Data Analysis and Synthesis

The extracted data were analyzed using qualitative synthesis. The studies were grouped based on MOF platform, type of therapeutic cargo, stimuli-responsive mechanism, and reported therapeutic outcome. The analysis also considered the annual distribution of publications and thematic keyword patterns to identify research trends in MOF-based cancer

drug delivery. The thematic visualization in the reviewed document indicates that recent studies strongly emphasize controlled release, cancer therapy, pH-responsive delivery, doxorubicin loading, ZIF-8, UiO-66, and targeted delivery. Therefore, the synthesis was directed toward explaining how MOF design, stimuli-responsive behavior, and therapeutic performance are connected in the development of targeted cancer drug delivery systems. To better understand the development of research interest in MOF-based cancer drug delivery systems, the annual distribution of publications included in this review was analyzed. The publication trend provides insight into the growth of scientific attention toward stimuli-responsive MOFs and their potential applications in targeted cancer therapy.

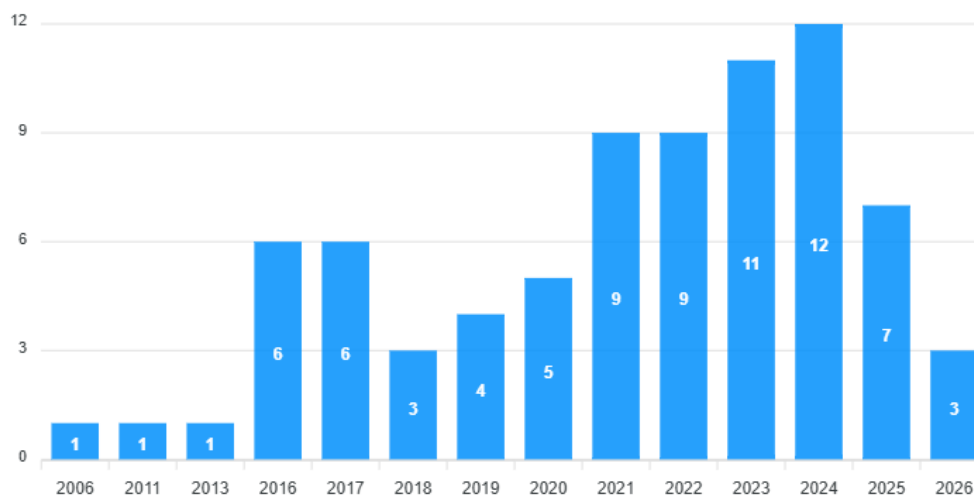


Figure 2. Annual Distribution of Articles Identified Through the Scopus Keyword Search

As shown in Figure 2, research activity on MOF-based cancer drug delivery has increased substantially over the last decade. Only a limited number of publications were reported before 2016, whereas a marked increase became evident from 2020 onward. The highest publication output was observed during 2023–2024, indicating growing scientific interest in stimuli-responsive MOFs as advanced nanocarriers for cancer therapy. This increasing trend reflects the rapid evolution of MOF design strategies, particularly toward controlled drug release, tumor-specific targeting, and multifunctional therapeutic applications. The growing research intensity also corresponds with the emergence of highly studied MOF platforms such as ZIF-8, UiO-66, and MIL-series structures, which dominate recent investigations.

III. THEORETICAL BACKGROUND

III.1 Metal-Organic Frameworks (MOFs)

Metal-Organic Frameworks (MOFs) are crystalline porous materials composed of metal ions or metal clusters coordinated to organic ligands, forming a three-dimensional network (Aliyu M. Hamisu, Azhar Ariffin, 2020)(Jiang et al., 2024)(Feng et al., 2025). Their structure is characterized by high surface area, tunable pore size, and versatile functionalization capabilities, making them ideal for encapsulating therapeutic agents. The ability to modify both the metal nodes and the organic linkers allows for the design of MOFs with specific chemical, physical, and biological properties suitable for biomedical applications. MOFs can be classified based on their metal center, topology, or functional characteristics. Common MOF types applied in drug delivery include ZIF-8, UiO-66, MIL-series, and HKUST-1. ZIF-8, for instance, demonstrates pH-sensitive degradability, which enables controlled drug release under

acidic tumor microenvironments. UiO-66 is valued for its chemical stability and functionalization potential, while MIL-series and HKUST-1 offer high drug loading capacity and compatibility with various therapeutic molecules (Katke et al., 2026). These properties make MOFs versatile nanocarriers capable of targeted and controlled drug delivery.

III.2 Drug Delivery Systems for Cancer Therapy

Drug delivery systems (DDS) are strategies or platforms designed to transport therapeutic agents to specific sites in the body, control the release kinetics, and improve therapeutic efficacy while minimizing side effects (Arora et al., 2011; Biglari et al., 2026; Impregnated & Silver, 2023; Katke et al., 2026). In cancer therapy, conventional drug administration faces several challenges including systemic toxicity, poor solubility, multidrug resistance, and non-specific targeting (Li et al., 2025). Nanocarrier-based DDS, including liposomes, polymeric nanoparticles, dendrimers, and MOFs, have emerged to overcome these limitations. MOFs distinguish themselves from other nanocarriers due to their high drug loading, structural tunability, and potential for stimuli-responsiveness. They can protect drugs from premature degradation, enhance circulation time, and provide site-specific delivery, thus improving the therapeutic index (Vaishali M. Patil, Satya P. Gupta, Neeraj Masand, Krishnan Balasubramanian, 2024).

Table 1. Summary of Selected Studies on MOF-Based Drug Delivery for Cancer Therapy (2010–2026)

No.	Author(s) & Year	MOF Type/ Platform	Drug/Cargo	Stimuli-Responsive Mechanism	Cancer Type/ Application	Key Findings /Therapeutic Performance
1	(Yan et al., 2020)	ZIF-8	Doxorubicin	pH-sensitive	Breast cancer	High loading efficiency, controlled release in acidic tumor environment, improved cytotoxicity
2	(Meng et al., 2024)	UiO-66	Doxorubicin	Redox-responsive	Liver cancer	Selective release triggered by glutathione, enhanced apoptosis, low systemic toxicity
3	(Yu et al., 2026)	MIL-100(Fe)	Cisplatin	pH + enzyme-responsive	Lung cancer	Dual-triggered release, improved tumor targeting, enhanced therapeutic index

4	(Gao et al., 2023)	ZIF-8GO	Doxorubicin + Photothermal agent	pH + NIR light	Breast cancer	Combined chemophotothermal therapy, high tumor ablation efficiency
5	(Maria et al., 2026)	HKUST-1	Doxorubicin	Temperature-responsive	Pancreatic cancer	Thermal-triggered release, enhanced cytotoxicity with localized heating
6	(Ghaee et al., 2026)	UiO-66-NH ₂	Gemcitabine	pH-sensitive	Ovarian cancer	Improved tumor accumulation, controlled drug release, reduced systemic toxicity
7	(Noori et al., 2025)	MIL-101(Cr)	Paclitaxel	Redox-responsive	Breast cancer	High drug loading, enhanced apoptosis, minimal off-target effects
8	(Jiang et al., 2024)	ZIF-8	Doxorubicin	pH-sensitive	Colon cancer	Efficient drug delivery, selective cytotoxicity toward tumor cells
9	(Bazzazan et al., 2023)	UiO-66	Cisplatin	Enzyme-triggered	Lung cancer	Improved cellular uptake, high antitumor efficacy, low systemic toxicity
10	(Tutunchi & Nabipour, 2025)	ZIF-8	Doxorubicin + Curcumin	pH + light-responsive	Breast cancer	Synergistic anticancer effect, precise controlled release, enhanced apoptosis

II.3 Trends in MOF Platforms

ZIF-8 and UiO-66 dominate the current research landscape as MOF platforms for cancer drug delivery. ZIF-8's pH-responsive degradation allows for rapid drug release in acidic tumor microenvironments, which has been widely exploited for doxorubicin delivery in breast, colon, and liver cancer models. UiO-66, on the other hand, offers superior chemical stability and functionalization potential, enabling surface modification with targeting ligands or combination therapy agents. MIL-series and HKUST-1 platforms, although less frequently studied, demonstrate high drug-loading capacities and potential for dual stimuli-responsive release. This distribution indicates that MOF selection is strongly influenced by the intended therapeutic cargo, desired stimuli-response mechanism, and target cancer type (Zhu et al., 2026).

III.4 Stimuli-Responsive Mechanisms

The reviewed studies highlight pH and redox as the most frequently utilized internal stimuli for drug release. Dual- or multi-stimuli-responsive MOFs, such as pH/light, pH/redox, or pH/enzyme, show enhanced selectivity and controlled release. External stimuli, including near-infrared (NIR) light and temperature triggers, are increasingly combined with MOFs to enable spatiotemporal control of drug release. These results underscore the importance of stimuli design in improving therapeutic efficacy and minimizing systemic toxicity. Moreover, multifunctional MOFs that integrate photothermal or photodynamic modalities with chemotherapy illustrate the potential of these platforms for combinatorial therapy, which may overcome limitations of single-drug treatment and address multidrug resistance (Ismail et al., 2022).

III.5 Therapeutic Performance and Limitations

Overall, MOF-based delivery systems demonstrate high drug-loading efficiency, controlled release, enhanced tumor targeting, and cytotoxicity against cancer cells. In vivo studies generally show tumor growth inhibition and reduced systemic side effects. However, despite promising preclinical results, clinical translation remains limited. Key challenges include long-term biosafety, immunogenicity, biodegradation kinetics, pharmacokinetics, reproducibility, and scalability. Many studies are confined to in vitro or small animal models, highlighting the gap between laboratory promise and human applicability.

III.6 Implications

The findings indicate that stimuli-responsive MOFs offer a robust strategy to improve cancer drug delivery. Their tunable architecture allows for controlled, targeted release and potential combinatorial therapy, which can enhance treatment efficacy while reducing systemic toxicity. However, for meaningful clinical impact, researchers must address translational challenges, including safety, reproducibility, and human applicability. This review provides a framework to guide future research, emphasizing the integration of material engineering with biological responsiveness and therapeutic performance.

VI. CONCLUSION

Stimuli-responsive MOFs represent a promising class of nanocarriers for targeted cancer drug delivery. Their tunable structure, high drug-loading capacity, and stimuli-responsive release enhance tumor selectivity and therapeutic performance. However, further in vivo validation, long-term safety studies, and translational research are needed to realize

clinical applications. Integration of material engineering, biological responsiveness, and therapeutic outcomes provides a roadmap for precision oncology.

VII. REFERENCES

- Abdollah Karami, Omnia Mohamed, Ahmed Ahmed, Ghaleb A Hussein, R. S. (2021). Recent Advances in Metal-Organic Frameworks as Anticancer Drug Delivery Systems: A Review. *Anticancer Agents Med Chem*, 21(18), 2487–2504.
- Aliyu M. Hamisu, Azhar Ariffin, Arief C. Wibowo. (2020). Cation exchange in metal-organic frameworks (MOFs): The hard-soft acid-base (HSAB) principle appraisal. *Inorganica Chimica Acta*, 511.
- Aliyu M. Hamisu, Azhar Ariffin, A. C. W. (2020). Cation exchange in metal-organic frameworks (MOFs): The hard-soft acid-base (HSAB) principle appraisal. *Inorganica Chimica Acta*, 511.
- Arora, R., Chawla, R., Marwah, R., Arora, P., Sharma, R. K., Kaushik, V., Goel, R., Kaur, A., Silambarasan, M., Tripathi, R. P., & Bhardwaj, J. R. (2011). Potential of Complementary and Alternative Medicine in Preventive Management of Novel H1N1 Flu (Swine Flu) Pandemic: Thwarting Potential Disasters in the Bud. *Evidence-Based Complementary and Alternative Medicine*, 2011(1). <https://doi.org/10.1155/2011/586506>
- Bazzazan, S., Moeinabadi-bidgoli, K., Asghari, Z., Bazzazan, S., Mehrarya, M., Eshrati, F., Hejabi, F., & Akbarzadeh, I. (2023). Journal of Drug Delivery Science and Technology Engineered UIO-66 metal-organic framework for delivery of curcumin against breast cancer cells : An in vitro evaluation. *Journal of Drug Delivery Science and Technology*, 79(August 2022), 104009. <https://doi.org/10.1016/j.jddst.2022.104009>
- Biglari, N., Ghomi, M., Nazarzadeh, E., & Mahmoudi, E. (2026). Toward multifunctional nanoplatforms based on layered double hydroxides (LDHs) for cancer therapy : From structural design to application. *Bioactive Materials*, 55(August 2025), 602–622. <https://doi.org/10.1016/j.bioactmat.2025.08.034>
- Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, J. A. (2018). Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin.*, 68, 394–424.
- Bui, A., Guillen, S. G., Sua, A., Nguyen, T. C., Ruiz, A., Carachure, L., Weber, M. D. R., Cortez, A., & Tian, F. (2022). Colloids and Surfaces A : Physicochemical and Engineering Aspects Iron-containing metal-organic framework thin film as a drug delivery system. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 650(June), 129611. <https://doi.org/10.1016/j.colsurfa.2022.129611>
- Chen, J., Wang, C., Zhu, Z., Wang, F., Shang, J., Liu, Z., & Wang, L. (2024). Journal of Solid State Chemistry Titanium-based metal-organic frameworks as pH-responsive drug delivery carriers of 5-Fluorouracil. *Journal of Solid State Chemistry*, 332(January), 124563. <https://doi.org/10.1016/j.jssc.2024.124563>
- Coluccia, M., Parris, V., Guglielmi, P., Giannini, G., & Secci, D. (2022). European Journal of Medicinal Chemistry Metal-organic frameworks (MOFs) as biomolecules drug delivery systems for anticancer purposes. *European Journal of Medicinal Chemistry*, 244(June), 114801. <https://doi.org/10.1016/j.ejmech.2022.114801>
- Feng, X., Zhao, J., Xie, M., Guo, Y., Xu, H., & Li, Y. (2025). Mussel biomimetic ZIF-8 nanoscale metal organic frameworks as stable and pH-responsive platforms for enhanced drug delivery. *Inorganic Chemistry Communications*, 179(P1), 114669. <https://doi.org/10.1016/j.inoche.2025.114669>
- Gao, S., Lv, R., Hao, N., Wang, H., Lv, Y., Li, Y., & Ji, Y. (2023). Colloids and Surfaces A : Physicochemical and Engineering Aspects Fabrication of pH / photothermal-responsive ZIF-8 nanocarriers loaded with baicalein for effective drug delivery and synergistic chem-photothermal effects. *Colloids and Surfaces A: Physicochemical and Engineering Aspects*, 668(April), 131401. <https://doi.org/10.1016/j.colsurfa.2023.131401>
- Ghaee, A., Shourangiz-haghighi, A., Bakhshian, A., Zhang, M., Kang, H., Dabiri, S., Malekpour, R.,

- Patel, S. K., Mitchell, M. J., Schirhagl, R., & Hassani, A. (2026). Stimuli-responsive nanodiamonds for precision pharmacokinetics. *Advanced Drug Delivery Reviews*, 232(February), 115822. <https://doi.org/10.1016/j.addr.2026.115822>
- Gu, D., Wang, Y., & Yang, Y. (2024). Journal of Drug Delivery Science and Technology Rational design of metal organic frameworks as the carriers for improving the efficiency of cancer drug delivery. *Journal of Drug Delivery Science and Technology*, 102(PA), 106378. <https://doi.org/10.1016/j.jddst.2024.106378>
- Impregnated, Z. M. F., & Silver, W. (2023). *Egyptian Journal of Chemistry*. 66(11), 119–124. <https://doi.org/10.21608/EJCHEM.2022.156592.6784>
- Ismail, E. A., Devnarain, N., Govender, T., & Omolo, C. A. (2022). Stimuli-responsive and biomimetic delivery systems for sepsis and related complications. *Journal of Controlled Release*, 352(October), 1048–1070. <https://doi.org/10.1016/j.jconrel.2022.11.013>
- Jiang, H., Bao, Q., Yang, T., Yang, M., & Mao, C. (2024). *Precision Treatment of Colon Cancer Using Doxorubicin-Loaded Metal – Organic-Framework-Coated Magnetic Nanoparticles*. <https://doi.org/10.1021/acsami.4c08602>
- Katke, S. P., Asiwal, E. P., Manjare, S. T., & Pawar, S. D. (2026). Chemistry of Inorganic Materials A comprehensive review of metal-organic frameworks for biomedical applications: Practical challenges and future potential. *Chemistry of Inorganic Materials*, 8(December 2025), 100139. <https://doi.org/10.1016/j.cinorg.2025.100139>
- Li, K., Guo, B., Gu, J., Ta, N., Gu, J., Yu, H., Sun, M., & Han, T. (2025). *Materials Today Bio Emerging advances in drug delivery systems (DDSs) for optimizing cancer complications*. 30(December 2024). <https://doi.org/10.1016/j.mtbio.2024.101375>
- Liu, Y., Xie, Y., Nie, X., & Yang, W. (2026). Research progress on metal-organic framework-based drug delivery systems for breast cancer treatment. *Colloid and Interface Science Communications*, 72(April), 100896. <https://doi.org/10.1016/j.colcom.2026.100896>
- Maria, A., Predeina, A., Paola, G., Tan, L., & Pellegrino, T. (2026). MOF composites for hyperthermia applications. *Materials Today*, 97(May), 103354. <https://doi.org/10.1016/j.mattod.2026.103354>
- Meng, X., Shen, Y., Zhao, H., Lu, X., Wang, Z., & Zhao, Y. (2024). *Redox-manipulating nanocarriers for anticancer drug delivery: a systematic review*.
- Noori, A., Salehi, M., Azaryan, E., & Ataei, M. (2025). Biomedicine & Pharmacotherapy Nanofibers for paclitaxel delivery: A promising avenue for cancer therapy. *Biomedicine & Pharmacotherapy*, 192, 118607. <https://doi.org/10.1016/j.biopha.2025.118607>
- Saleem, S., Kaur, K., Kumar, V., Ali, A., & Malik, A. (2024). An overview of Metal – Organic Frameworks as potential platform: Sensing for detection environmental pollutants and drug delivery applications. *Journal of Molecular Structure*, 1312(P1), 138389. <https://doi.org/10.1016/j.molstruc.2024.138389>
- Tutunchi, H., & Nabipour, H. (2025). *Curcumin-Loaded Nanoscale Metal – Organic Frameworks for Therapeutic Applications in Cancer*. 1–16.
- Vaishali M. Patil, Satya P. Gupta, Neeraj Masand, Krishnan Balasubramanian. (2024). Experimental and computational models to understand protein-ligand, metal-ligand and metal-DNA interactions pertinent to targeted cancer and other therapies. *European Journal of Medicinal Chemistry Reports*, 10.
- Yan, J., Liu, C., Wu, Q., Zhou, J., Xu, X., Zhang, L., & Wang, D. (2020). *Mineralization of pH-Sensitive Doxorubicin Prodrug in ZIF - 8 to Enable Targeted Delivery to Solid Tumors*. <https://doi.org/10.1021/acs.analchem.0c02599>
- Yu, H., Lin, G., & Mi, P. (2026). *Theranostics Recent advances of metal-organic frameworks (MOFs) for drug delivery , cancer imaging and theranostics*. 16(9). <https://doi.org/10.7150/thno.128435>
- Zhu, X., Liao, M., Wei, H., Jiang, Y., Cheng, H., & Xu, X. (2026). *Materials Today Bio Advances and challenges of metal-organic frameworks in controlled drug delivery*. 38(May).