

# Review Article: The Ethical Implications of Artificial Intelligence in Medical Diagnostics

**Mitra Akbari, M.D**

Eye Research Center, Department of Eye, Amiralmomenin Hospital, School of Medicine, Guilan University of Medical Science, Rasht, Iran (ORCID ID; 0000-0003-2469-2681)



**Citation** M Akbari, *The Ethical Implications of Artificial Intelligence in Medical Diagnostics*, *EJCMPR*. 2025; 4(2): 164-174.

 <https://doi.org/10.5281/zenodo.18799170>

## Article info:

**Received:** 07 November 2024

**Accepted:** 20 January 2025

**Available Online:**

**ID:** EJCMPR-2501-1278

**Checked for Plagiarism:** Yes

**Peer Reviewers Approved by:**

Dr. Frank Rebout

**Editor who Approved Publication:**

Dr. Frank Rebout

## Keywords:

artificial intelligence, medicine, gross error, ethical issues, patient.

## ABSTRACT

The field of AI ethics has become a global enterprise with a wide range of actors. However, AI ethics is not new. With new uses of AI, AI ethics has flourished beyond academia. For example, in 2021, UNESCO appointed 24 experts from around the world and launched a global online consultation on AI ethics to facilitate dialogue and exchange of views with all member states. One of the major problems that AI ethics and ethicists may face is the ambiguity of what is actually happening in AI, given that understanding what is good about an activity is itself very useful in determining its ethical issues. Despite the lack of transparency of AI in its current form, the important point is what kind of ethical issues can arise due to the use and development of this technology, which is a matter of debate and investigation. Another concern is transparency and explainability. Many AI systems act like black boxes. The decision-making process is not transparent. This undermines trust among healthcare providers and patients and their companions. It is unacceptable in the medical field that even the designers of AI systems do not know exactly how AI reached a particular result due to the complexity of algorithms such as artificial neural networks. Because we are dealing with human lives here. The challenge of human decision-making is also raised. The use of medical automation processes can reach the point where AI judgment is pitted against human judgment. Relying on AI for diagnostic or treatment decisions raises questions about the role of humans. Although the use of processing power and big data reduces the error rate of AI results, who will be responsible if AI makes a mistake? In the case of a doctor, no matter how erroneous and inaccurate, we ultimately know that the moral responsibility for medical errors or adverse consequences of treatment decisions rests with no one but him, but the issue of the moral responsibility of AI is a complex one.

## Introduction

Among the ethical challenges in this field is resistance to collecting too much information from students [1]. The next challenge is to protect the anonymity and privacy of

individuals [2]. Given that AI-based systems use a lot of students' private data and it is almost impossible to anonymize the data, when using AI in medical education, attention should be paid to whether students are aware of and consent to the collection of data from them, and

\*Corresponding Author: **Mitra Akbari** ([mitra.akbari20@gmail.com](mailto:mitra.akbari20@gmail.com))

if so, to what extent their consent is voluntary or mandatory? Another challenge is protecting the ownership of student data. In fact, medical education institutions must consider students' ownership rights and its consequences both in relation to data that the institution creates about students, such as grades, evaluations, and in relation to data created by students themselves, such as assignments, projects [3].

### Research Method

This study is theoretical and its method is descriptive-analytical. The data collection tools were from evidence sources of the Web of Science, PubMed, Scopus and Google Scholar databases, which are through extensive literature review, analysis, scientific research and opinions of leading individuals in this field and a guide to understanding the nature.

### The development of ethics in AI can have significant applications not only in the fields of medicine, law, and business, but also in the audio and sound systems industry

For example, in the design of smart audio systems, types of speakers, and headphones that use AI to personalize the listening experience, the existence of ethics-based algorithms can help improve human-technology interactions [4].

A clear example would be smart voice systems that use voice assistants. These assistants need to not only understand people's voice commands, but also make ethical decisions in responding to different needs. For example, a smart speaker with content recognition capabilities should be able to distinguish between content suitable for children and adults, or smart headphones can make ethical decisions to protect the individual based on environmental conditions, such as detecting audio hazards [5].

Developing ethical principles for responsible use and development of AI requires

collaboration between industry stakeholders. Stakeholders need to examine how social, economic, and political issues intersect with AI and determine how machines and humans can coexist harmoniously [6].

The next important challenge is algorithmic bias, which can affect the conclusions reached with the help of artificial intelligence. One of these biases is the general stereotypes in data labeling, which can be transferred to artificial intelligence algorithms and cause inappropriate weighting to specific data or finding unfounded connections between data [7].

For example, until recent years, searching for the phrase "healthy skin" in search engines showed only images of young women with white skin and European ethnicity as search results. As a result, algorithms developed based on these images did not have sufficient accuracy and efficiency for people of color [8]. Finally, one of the most important challenges of using artificial intelligence in medical sciences is the dynamism and high speed of development and expansion of artificial intelligence, the mass of data and its functions, which can make traditional and closed methods of education in medicine ineffective against its consequences [9].

Therefore, it is necessary to develop dynamic, agile and up-to-date systems in the field of medical education in such a way that it can keep up with the progress of artificial intelligence and respond to the side issues and challenges arising from it [10].

Despite the ethical challenges in using artificial intelligence in medical education (Figure 1), these challenges can be minimized by using solutions [11].

Applying special sensitivity to the correct performance of algorithms used in education and treatment and early and effective detection of possible biases of algorithms used in artificial intelligence are among the most

important issues in this field. Proper management of mass data while maintaining privacy can overcome many of the ethical challenges in this field. Forming a special ethics committee in education, in which in addition to

medical ethics experts, artificial intelligence experts are also used, is another effective solution in preventing and managing ethical challenges resulting from the use of artificial intelligence in medical education [12].



**Figure 1.** The Ethical Implications of Artificial Intelligence in Medical Diagnostics

In addition, continuous training of faculty members, students, and university personnel in the field of artificial intelligence and its ethical aspects can be another effective practical measure in reducing ethical challenges in this field. Today, the use of artificial intelligence in healthcare systems has become common, including electronic imaging, laboratory diagnostics, treatment, discovery of new drugs, precise medical prevention, biological data, etc. Despite the many advantages of using artificial intelligence in medicine, this technology can act as a double-edged sword that is related to ethical issues and includes privacy, data protection, informed consent, social gaps, medical consultation, empathy and sympathy [13].

Also, the emergence of surgical robots and robotic nurses operating instead of surgeons and caring for patients instead of nurses threatens their job opportunities and future. On the other hand, patients will not have a sense of empathy and appropriate behavior when dealing with robotic doctors and nurses. Because these robots do not have human

characteristics, which is considered another major ethical and social problem. Therefore, it is appropriate for healthcare system specialists to consider important principles of medical ethics such as independence, beneficence, non-abuse and justice in their professional practice [14].

### Formulating the Ethics of Artificial Intelligence

The European Commission and UNESCO are among the centers that have made recommendations in the field of AI ethics. The European approach has a human-centered view of AI ethics. This means that AI is not an end in itself, but a way to improve the human condition. In fact, they both seek AI and do not seek it. The main goal is to expand the opportunities that are favorable to humans and control its risks. According to European Commission experts, good AI should have three characteristics:

- 1- Be legal and respect the law.
- 2- Be ethical and adhere to values.

3- It should be robust and accurate and operate in accordance with technical standards [15].

### **The European Commission considers four ethical principles for AI:**

First, AI should guarantee human autonomy. Humans should not be subject to force or coercion in using AI. When an institution or even a government forces people to use AI, or directs them towards it with propaganda, it should be suspected [16]. Imagine, using an app helps you stay healthy and fit, but when an insurance company asks you to use the same app to get an insurance discount, the story becomes a little different. Here, one must wonder what the insurance company's goal is and why it is making such a request to citizens? The second ethical principle is the prevention of physical and psychological harm. Artificial intelligence must prevent physical and psychological harm to humans [17].

The third principle is that artificial intelligence must be fair. It is natural that artificial intelligence must follow the principle of justice. Of course, the European Commission experts themselves have realized that there are different definitions of justice.

Finally, the fourth principle is related to the clarity and explainability of artificial intelligence. Transparency and traceability of the actions of those involved in artificial intelligence are important and challenging principles. UNESCO is another center that has made recommendations in the field of artificial intelligence ethics. [18]

According to UNESCO, cultural diversity must be taken into account to regulate the ethics of artificial intelligence. UNESCO believes that artificial intelligence is a global phenomenon and global organizations should set a framework for it. In the section on the ethics of artificial intelligence, UNESCO mentions respect for human rights and human dignity. It also refers to the environment and ecosystem.

In the following paragraphs, UNESCO reminds us of peaceful societies and the spread of justice. Other principles that UNESCO states include non-harm, non-discrimination, privacy, transparency, and accountability [19].

### **European Ethics**

Although UNESCO believes that there is a long way to go before these principles are implemented, assuming that their European-ethical principles are correct, the story does not end so easily. Generalizations and vague statements open the way for personal and biased opinions.

If Russia and Israel use artificial intelligence to the same extent to wage war, will they be condemned to the same extent? Have Russia and Israel violated human rights to the same extent? When you talk about human dignity, human rights, justice, or even physical and psychological harm, what exactly is the definition of these words? What is your definition of dignity, rights, justice, and humanity?

Is not recognizing homosexuals in the creation of an algorithm for a talking robot an example of inflicting psychological harm on these people? These are questions that challenge the discussion of the ethics of artificial intelligence [20]. A discussion that takes a long time to complete.

### **Need for large investments**

Current AI tools, in addition to the large amount of information, also require significant hardware power, which requires very large investments and there are many restrictions on access to it. ChatGPT was the most important product that made AI very popular over the past year, but if we look at its infrastructure, we realize that it consumes about half a million kilowatts of electricity per day, which is equivalent to the consumption of about 200,000 homes, and a lot of water is consumed

to keep its thousands of processors cool. Interestingly, an unofficial study estimated the cost of maintaining ChatGPT to be close to a million dollars per day [21].

### Lack of a standard framework

Currently, there is no defined standard for building medical AI tools. It is necessary to develop a general framework so that all production tools follow its instructions and important issues are identified. Including:

How to collect data?

What is the process of verifying data?

How should ethical considerations be considered?

### Ethical principles in the development of artificial intelligence

AI developers must adhere to ethical principles at all stages of the development of this technology. These principles include fair design, transparency in decision-making, responsibility and accountability for the results of artificial intelligence [22]. Also, the issue of equity in access to health care is another important ethical challenge. Although artificial intelligence can help improve the quality of care and reduce costs, care must be taken to ensure that these technologies are equally and fairly available to all patients [23].

On the other hand, artificial intelligence can provide unique opportunities for medicine. The use of AI in more accurate diagnosis of diseases, prescribing personalized treatments and reducing medical errors are among these opportunities. Artificial intelligence can also help doctors devote more time to direct patient care, instead of spending a lot of time on administrative tasks. Ultimately, AI is not the end of medicine, but rather the transformation and improvement of it. To achieve this goal, it is essential that doctors, IT professionals, policymakers, and the patient community work together to reap the benefits of AI while

managing its ethical challenges. An important question in the debate about AI's end of medicine is whether doctors will actually become unemployed [24].

The answer to this question depends not only on AI technology, but also on how it is used and integrated into healthcare systems. AI is certainly changing the face of medicine. From more accurate diagnosis of diseases to the development of personalized treatments, AI offers new opportunities to improve healthcare, but this does not mean that the role of doctors will disappear, but rather that it will evolve. Doctors will have to learn new skills and keep up with new technologies in order to reap the benefits of AI [25].

Furthermore, AI cannot fully replace human capabilities such as empathy, moral judgment, and personal experience. These characteristics are crucial in treating patients and play a key role in the doctor-patient relationship. Ultimately, the destruction of medicine by AI is an exaggeration. AI acts more as an auxiliary tool that can improve the quality and accuracy of diagnosis and treatment, but it cannot fully replace human capabilities. Therefore, a combination of traditional medical knowledge and modern technologies can be an ideal solution to the challenges facing health systems in the future. Below is a more detailed explanation of each of these principles:

**A) Equitable design:** Equitable design means creating systems that are non-discriminatory and work for the benefit of all social groups. This includes using diverse and representative data from society, avoiding reinforcing existing biases, and creating algorithms that act fairly. For example, AI hiring systems need to ensure that algorithms do not discriminate in favor of any particular group and provide job opportunities fairly to all applicants [26].

**B) Transparency in decision-making:** Transparency in AI decision-making means that users and stakeholders can easily

understand how and why an algorithm reached a particular conclusion. This includes providing detailed and understandable explanations of decision-making processes, providing information about the data used, and providing tools for reviewing and analyzing the results. This information should be presented in a way that is understandable to ordinary users, not just technical experts. Transparency can help increase user trust in AI systems and reduce the possibility of bias and inequality [27].

**C) Accountability:** Accountability means that developers and companies using AI should be held accountable for the results and impacts of this technology. This includes accepting responsibility for incorrect or unfair decisions, promptly correcting problems, and providing compensation to those affected. Accountability also includes establishing oversight processes to continuously evaluate and control the performance of AI systems [28].

**D) Accountability:** Accountability also means that developers and companies must be held accountable for the results and impacts of AI. This includes establishing mechanisms to investigate and correct problems, providing clear and understandable explanations of decisions, and providing compensation to those affected. For example, if an AI system unfairly makes a decision that harms an individual, the responsible company must establish processes to investigate and correct the decision and provide compensation [29].

**E) Interaction with other disciplines:** A key aspect of developing more just and ethical AI is interaction and collaboration across disciplines. Disciplines such as psychology, sociology, and law can play a very important role in this [30].

Below, we have discussed the importance and role of these fields in the development of artificial intelligence:

**1- Psychology:** Psychology can help understand human behavior and the effects of

artificial intelligence on their psyche and mind. This knowledge can help artificial intelligence developers to better understand the needs and reactions of users and design systems that have fewer negative effects on the mental health of users. For example, psychological studies can help identify stressful or anxiety-provoking reactions of users when faced with artificial intelligence systems and provide solutions to reduce these effects [31].

**2- Sociology:** Sociology can help better understand social interactions and the effects of artificial intelligence on society. This field can identify and analyze the social effects of artificial intelligence and the biases it contains. For example, sociologists can study the effects of crime prediction systems on different societies and help developers design more fair and unbiased algorithms. Sociology can also help to better understand the inequalities and injustices existing in society and provide solutions to reduce these problems [32].

**3- Law:** Law can play a very important role in regulating and creating legal frameworks for the use of artificial intelligence. Lawyers can help developers design systems that are consistent with legal and legal principles by reviewing and analyzing existing laws. In addition, lawyers can help create new and updated laws to manage and control the use of artificial intelligence. These laws can include ethical principles, privacy protection, and liability for the results of artificial intelligence. Large Internet companies such as Google and Amazon use the data they collect about potential customers to advertise goods and services that their algorithms show searchers need or are looking for [33].

This approach can easily be combined with the concept of “primary vulnerable moments,” where real-time data analysis is used to identify such moments in much greater detail than the original study. The manipulation and intrusion described in this second case study is

now so widespread that it may no longer be noticeable. Most internet users are used to being targeted by advertisements. The interesting angle here is the use of “primary vulnerable moment,” which is not yet a concept widely referenced in AI marketing. The lack of a word for this concept does not mean that a fundamental approach is not being used. The company that conducted the original research expressed this approach in a positive and supportive way [34].

The result of such a marketing strategy may actually be positive for the target audience. If someone is having a vulnerable moment due to fatigue, the corresponding health and wellness suggestions may help combat that state. This leads us to the question, under what circumstances does manipulation and influence occur, and how can it be evaluated from an ethical perspective?

An ethical analysis of the concept of manipulation must begin with an acknowledgement that the term has ethical implications [35].

The Cambridge Online Dictionary provides the following definition: “The control of someone or something for one’s own benefit, often unfairly or dishonestly.” The Cambridge Dictionary also adds that the behavior is presented in a way that is distasteful. So this definition provides several reasons why manipulation and influence are morally problematic?

The act of controlling others may be seen as disturbing, especially when it is done for one’s own benefit, which if done unfairly or dishonestly, creates a sense of unease about it. In traditional philosophical terms, it is Kant’s categorical imperative that such manipulation and influence are morally prohibited. Because a person is merely being used as a means to achieve another’s personal ends [36].

One aspect of the debate related to the first case study is that voter manipulation through AI

could harm democracy. Voter manipulation using AI could be influenced by voters. It is unclear, however, under what circumstances such influence on voters would be illegitimate? After all, election campaigns are explicitly aimed at influencing voters, and doing so is the everyday work of politicians.

It seems that this happens not so much under the influence of voters as without their knowledge and perhaps in a way that ignores their ability to critically reflect on election messages. An additional concern is the fact that AI is mostly owned and used by large corporations and that they already have a large influence on policy decisions, which could be further enhanced by their ability to influence voters [37].

Artificial intelligence is currently one of the most controversial topics in the world today. The present study examines the actual and potential ethical issues in medical artificial intelligence. The increasing advancement of artificial intelligence and digital processing has created many useful applications in various sectors including banking, agriculture, medical practices and even military operations, especially by reducing human intervention in sensitive and dangerous activities. Robots, as well as computers, are the embodiment of values [38].

Because they are able to perform actions and choices that have been modeled and programmed by the engineers who created them. Ensuring the safety of the operation of such systems is achieved through algorithmic methods [39].

Artificial intelligence algorithms can naturally contain errors that may lead to unforeseen consequences and unfair outcomes along economic and racial lines. It is necessary to establish policies, regulations and measures to monitor technological developments and combine ethical issues with engineering science to ensure that the rights of individuals

are protected against direct or indirect threats. Although it is the task of AI researchers to explain the promising future of this technology, ethicists and philosophers should be involved in the development of such technologies from the beginning [40].

### Conclusion

Today, artificial intelligence technologies can provide unimaginable benefits to the health system. While artificial intelligence has significant potential to improve the performance of the health system. On the other hand, it also brings challenges that sometimes lead to harm in the health system. Therefore, the purpose of the present study is to answer the question of what ethical and legal challenges are associated with the application of artificial intelligence in the health system.

The findings of the study indicate that the most important ethical challenges include trust in artificial intelligence, standardization of artificial intelligence in medicine, compliance with medical ethics in artificial intelligence, artificial intelligence in diagnosing the end of treatment, and artificial intelligence and emotional functioning. The most important legal challenges of artificial intelligence in the health system include violation of human dignity, civil liability, physician liability, cybersecurity, and violation of privacy.

In using artificial intelligence technologies that we use in the health system for health and medical services, our decisions should be based on observing ethical and legal principles and rules and regulations that do not violate human dignity. Any artificial intelligence-based technology that is considered for use in health care and the health system must be efficient, safe, capable of continuous monitoring, standardized, and regulated. Such technologies can only be efficient if they are successfully implemented in health care. Predicting the long-term consequences of artificial

intelligence in medicine, whether positive or negative, is difficult and requires continuous evaluation. However, a number of things are certain. For example, healthcare professionals are concerned that AI will take over certain job roles in healthcare, leading to job losses. It is understandable that integrating AI into existing healthcare systems will encounter resistance from doctors and nurses who are accustomed to traditional methods. Healthcare professionals and experts also need training to use AI tools, which takes time and resources. Another issue that we can start to worry about now is the uneven distribution of technological achievements and opportunities for people around the world.

The use of AI in medicine will increase the quality of healthcare and save lives. However, addressing the ethical challenges and considerations for the responsible and effective use of technology is crucial. This will require joint efforts by technologists, healthcare professionals, ethicists, policymakers, and patients themselves to establish solid frameworks for the ethical and equitable use of AI in medicine. By carefully examining and managing these challenges, it is hoped that AI will be a transformative force in the field of medicine while maintaining the highest ethical standards.

**Ethical considerations:** In all stages of writing this study, honesty and trustworthiness have been observed, while respecting the originality of the texts.

### References

- [1] Moradi A, Abedini N, Effect of Dministration of Tranexamic Acid in Total Knee Arthroplasty, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1, 111-125 [[Google Scholar](#)], [[Publisher](#)]
- [2] Ahmadi M.H., Ghazvini M., Alhuyi Nazari M., Ahmadi M.A., Pourfayaz F., Lorenzini G., Ming T. Renewable energy harvesting with

the application of nanotechnology: A review. *International Journal of Energy Research*, **2019**, 43:1387 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[3] Alshorifi F.T., El Dafrawy S.M., Ahmed A.I. Fe/Co-MOF nanocatalysts: greener chemistry approach for the removal of toxic metals and catalytic applications. *ACS Omega*, **2022**, 7:23421 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[4] Amigun A.T., Adekola F.A., Tijani J.O., Mustapha S. Photocatalytic degradation of malachite green dye using nitrogen/sodium/iron-TiO<sub>2</sub> nanocatalysts. *Results in Chemistry*, **2022**, 4:100480 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[5] Awogbemi O., Ojo A.A., Adeleye S.A. Advancements in the application of metal oxide nanocatalysts for sustainable biodiesel production. *Discover Applied Sciences*, **2024**, 6:250 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[6] Chen M., Kang H., Gong Y., Guo J., Zhang H., Liu R. Bacterial cellulose supported gold nanoparticles with excellent catalytic properties. *ACS Applied Materials & Interfaces*, **2015**, 7:21717 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[7] Ćwieka K., Czelej K., Colmenares J.C., Jabłczyńska K., Werner Ł., Gradoń L. Supported plasmonic nanocatalysts for hydrogen production by wet and dry photoreforming of biomass and biogas derived compounds: recent progress and future perspectives. *ChemCatChem*, **2021**, 13:4458 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[8] Da Y., Li X., Zhong C., Deng Y., Han X., Hu W. Advanced characterization techniques for identifying the key active sites of gas-involved electrocatalysts. *Advanced Functional Materials*, **2020**, 30:2001704 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[9] Fierascu R.C., Ortan A., Avramescu S.M., Fierascu I. Phyto-nanocatalysts: Green

synthesis, characterization, and applications. *Molecules*, **2019**, 24:3418 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[10] Gaikwad D.N., Gaikwad S.T., Manjul R.K., Rajbhoj A.S., Suryavanshi D.M., Varade G.A., Dhane N.S. A comprehensive overview of recent trends in the production of nitrogen-containing heterocyclic compounds using nanocatalysts. *Letters in Organic Chemistry*, **2025**, 22:102 [[Crossref](#)], [[Publisher](#)]

[11] Guo Y., Gonzalez S., Guadalupe A.R., Transmission electron microscopy characterization and application of sol-gel membranes. *Microscopy and Microanalysis*, **1999**, 5:445 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[12] Jang W., Yun J., Ludwig L., Jang S.G., Bae J.Y., Byun H., Kim J.H. Comparative catalytic properties of supported and encapsulated gold nanoparticles in homocoupling reactions. *Frontiers in Chemistry*, **2020**, 8:834 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[13] Hashemzadeh K, Dehdilan M, Results of Cardiac Surgeries in Pediatric Requiring Cardiac Surgery Hospitalized in the Intensive Care Unit, *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, **2022**, 1 (4), 189-197 [[Google Scholar](#)], [[Publisher](#)]

[14] Karczmarska A., Adamek M., El Houbbadi S., Kowalczyk P., Laskowska M. Carbon-supported noble-metal nanoparticles for catalytic applications—a review. *Crystals*, **2022**, 12:584 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[15] Lu H.H., Lu M.C., Le T.C., An Z., Pui D.Y., Tsai C.J. Continuous improvements and future challenges of air pollution control at an advanced semiconductor fab. *Aerosol and Air Quality Research*, **2023**, 23:230034 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[16] Dehdilan M, Hashemzadeh K, Length of stay in the hospital and intensive care unit in patients after heart valve surgeries, *Eurasian Journal of Chemical, Medicinal and Petroleum*

- Research, **2022**, 1 (4), 198-209 [[Google Scholar](#)], [[Publisher](#)]
- [17] Irajian M, Fattahi V, Investigating the Effect of Tranexamic Acid on Reducing Bleeding in Knee Arthroplasty and Improving Joint Function: A systematic review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (4), 210-222 [[Google Scholar](#)], [[Publisher](#)]
- [18] Navia-Mendoza J.M., Filho O.A.E., Zambrano-Intriago L.A., Maddela N.R., Duarte M.M.M.B., Quiroz-Fernández L.S., Baquerizo-Crespo R.J., Rodríguez-Díaz J.M. Advances in the application of nanocatalysts in photocatalytic processes for the treatment of food dyes: A review. Sustainability, **2021**, 13:11676 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [19] Nguyen V.H., Vo D.V.N. Editorial for the special issue on nanocatalysts for environmental remediation, biomass and waste valorization. Topics in Catalysis, **2023**, 66:1 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [20] Baradaran Bagheri R, Managing Brain Tumors in In Vitro Fertilization Pregnancy: Systematic Review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (4), 223-236 [[Google Scholar](#)], [[Publisher](#)]
- [21] Baradaran Bagheri R, Oxytocin During Elective Caesarean Section and Risk of Severe Postpartum Haemorrhage, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (5), 126-139 [[Google Scholar](#)], [[Publisher](#)]
- [22] Yasrebi S, Baradaran Bagheri R, Effect of Enoxaparin's Ability to success and Neonatal out Come of In Vitro Fertilization, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (5), 140-152 [[Google Scholar](#)], [[Publisher](#)]
- [23] Safavi A., Tohidi M. Microwave-assisted synthesis of gold, silver, platinum and palladium nanostructures and their use in electrocatalytic applications. Journal of Nanoscience and Nanotechnology, **2014**, 14:7189 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [24] Singh R., Dutta S. Current approaches of nanotechnology for potential drinking water purification. Handbook of Research on Emerging Developments and Environmental Impacts of Ecological Chemistry, **2020**, 307 [[Google Scholar](#)], [[Publisher](#)]
- [25] Singh S., Kumar V., Datta S., Bhatia D., Dhaka V., Singh J. Novel strategies for environmental remediation of pesticides using nanocatalysts. Biobased Nanotechnology for Green Applications, **2021**, 543 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [26] Fattah V, Irajian M, Investigating the Effect of Hyaluronic Acid on Pain Control in Total Ankle Arthroplasty: A systematic review, Eurasian Journal of Chemical, Medicinal and Petroleum Research, **2022**, 1 (5), 23-40 [[Google Scholar](#)], [[Publisher](#)]
- [27] Verma V., Joshi A., Kalra S., Singh A., Mohan C. Novel Nanocatalysts for Sustainable Hydrogen Production from Renewable Resources. E3S Web of Conferences: EDP Sciences, **2024**, 01006 [[Google Scholar](#)], [[Publisher](#)]
- [28] Yang Y. Towards a more sustainable chemical process industry: engineering nanocatalysts for natural gas utilization and carbon dioxide conversion. University of Pittsburgh, **2019** [[Google Scholar](#)], [[Publisher](#)]
- [29] Zelekew O.A., Haitosa H.H., Chen X., Wu Y.N. Recent progress on plant extract-mediated biosynthesis of ZnO-based nanocatalysts for environmental remediation: Challenges and future outlooks. Advances in Colloid and Interface Science, **2023**, 317:102931 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [30] Zhou J., Wei N., Zhang D., Wang Y., Li J., Zheng X., Wang J., Alsalloum A.Y., Liu L., Bakr O.M. Cryogenic focused ion beam enables atomic-resolution imaging of local structures in

highly sensitive bulk crystals and devices. *Journal of the American Chemical Society*, **2022**, 144:3182 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[31] Mahanur V.B., Rajge R.R., Pal R.S., Chaitanya M., Vishwas S., Gupta S., Gupta G., Kumar D., Oguntibeju O.O., ur Rehman Z., Harnessing unexplored medicinal values of red listed south african weed erigeron bonariensis: From ethnobotany to biomedicine, *South African Journal of Botany*, **2023**, 160:535 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[32] Dubale S., Kebebe D., Zeynudin A., Abdissa N., Suleman S., Phytochemical screening and antimicrobial activity evaluation of selected medicinal plants in ethiopia, *Journal of experimental pharmacology*, **2023**, 51 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[33] Abood M.A., Kadhim E.J., Phytochemical investigation of some active components in iraqi conyza canadensis (syn. *Erigeron canadensis*), *IJDDT*, **2021**, 11:669 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[34] Usman H., Abdulrahman F.I., Usman A., Qualitative phytochemical screening and in vitro antimicrobial effects of methanol stem bark extract of ficus thonningii (moraceae), *African Journal of Traditional, Complementary and Alternative Medicines*, **2009**, 6 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[35] Dubale S., Kebebe D., Zeynudin A., Abdissa N., Suleman S., Phytochemical screening and antimicrobial activity evaluation of selected medicinal plants in ethiopia, *Journal of Experimental pharmacology*, **2023**, 51 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[36] Ramya S., Chandran M., King I.J., Jayakumararaj R., Loganathan T., Pandiarajan G., Kaliraj P., Pushpalatha G.G.L., Abraham G., Vijaya V., Phytochemical screening, gcms and ftir profile of bioactive compounds in solanum lycopersicum wild fruits collected from palani hill ranges of the western ghats, *Journal of Drug Delivery and Therapeutics*, **2022**, 12:56 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[37] Rautela A., Rani J., Green synthesis of silver nanoparticles from tectona grandis seeds extract: Characterization and mechanism of antimicrobial action on different microorganisms, *Journal of Analytical Science and Technology*, **2019**, 10:1 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[38] Fu W., Chen J., Cai Y., Lei Y., Chen L., Pei L., Zhou D., Liang X., Ruan J., Antioxidant, free radical scavenging, anti-inflammatory and hepatoprotective potential of the extract from parathelypteris nipponica (Franch. et Sav.) ching, *Journal of Ethnopharmacology*, **2010**, 130:521 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[39] Arya S.S., Pegu K., Sadawarte P.D. Bioactive Compounds and Health Benefits of Jamun (*Syzygium cumini*), In *Bioactive Molecules in Food*, **2019**, 2297 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[40] Cyril N., George J.B., Joseph L., Raghavamenon A., VP S., Assessment of antioxidant, antibacterial and anti-proliferative (lung cancer cell line A549) activities of green synthesized silver nanoparticles from derris trifoliata, *Toxicology Research*, **2019**, 8:297 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

---

This journal is a double-blind peer-reviewed journal covering all areas in Chemistry, Medicinal and Petroleum. EJCMPR is published quarterly (4 issues per year) online and in print. Copyright © 2025 which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.