journal of PROGRESSIVEISLAM
e-ISSN: 3141-1010 | Volume 1, (May 2026)

Received	12 Jan 2026	Revised	30 Apr 2026
Accepted	23 May 2026	Published	1 May 2026
Page	1-14		
DOI	https://doi.org/10.24035/jopi.01.2026.01		

Artificial Intelligence in Prenatal Diagnosis: Ethical Reflections from an Islamic Perspective

Ahmad Luqmanulhakim Sunawari[1], Muhammad Roflee Waehama[2] & Azira Khalil*[3]

Abstract

Recent advances in artificial intelligence (AI) have significantly influenced the field of medical imaging, including prenatal diagnosis. AI-based systems, particularly those employing machine learning and deep learning algorithms, have demonstrated promising capabilities in analyzing ultrasound images for the detection of fetal abnormalities. These technologies have been applied to identify conditions such as congenital heart defects, neurological abnormalities, skeletal disorders, and pregnancy-related complications, thereby supporting clinicians in improving diagnostic accuracy and early detection. Despite these technological benefits, the integration of AI into prenatal medicine also raises important ethical concerns, particularly regarding parental decision-making, diagnostic uncertainty, and the responsible use of automated medical systems. This paper examines the role of artificial intelligence in prenatal diagnosis and explores its ethical implications from an Islamic perspective. By integrating insights from medical science with Islamic ethical principles, the study analyzes how emerging diagnostic technologies may align with the objectives of Islamic law (Maqasid al-Shariah), particularly the preservation of life (ḥifẓ al-nafs) and the preservation of lineage (ḥifẓ al-nasl). The discussion highlights the importance of ensuring that AI functions as a supportive clinical tool rather than a replacement for human medical judgement. Ultimately, the study argues that Islamic ethical principles provide valuable guidance for the responsible integration of artificial intelligence in prenatal healthcare while maintaining respect for human dignity and moral accountability.

Keywords: Artificial intelligence, fetal abnormalities, Islamic bioethics, medical imaging, prenatal diagnosis.

[1]Ahmad Luqmanulhakim Sunawari, Ph.D. Candidate at the Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Negeri Sembilan, MALAYSIA. [0000-0002-5032-7357].
[2]Muhammad Roflee Waehama, Ph.D. Assist. Prof., Faculty of Islamic Sciences, Prince Songkhla University, Pattani Campus, THAILAND. [0000-0001-8679-7345].
[3]Azira Khalil* (*Corresponding Author*), Ph.D., Assoc. Prof., Faculty of Science and Technology, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Negeri Sembilan, MALAYSIA. [0000-0003-0661-0064].

Introduction

Recent advancements in artificial intelligence (AI) have significantly transformed the landscape of modern healthcare. AI-driven systems, particularly those based on machine learning (ML) and deep learning (DL), are increasingly applied in medical imaging to enhance diagnostic accuracy, automate image analysis, and assist clinical decision-making. Among these applications, prenatal imaging has emerged as a crucial area in which AI technologies can contribute to the early detection of fetal abnormalities (He et al., 2021). Ultrasound remains the primary imaging modality for prenatal screening due to its safety, accessibility, and real-time imaging capabilities. With the integration of AI algorithms such as convolutional neural networks (CNNs), medical practitioners can analyze complex ultrasound patterns more efficiently and potentially identify congenital abnormalities at earlier stages of pregnancy.

Early detection of fetal abnormalities including congenital heart defects, neurological malformations, skeletal dysplasias, and placental complications plays a critical role in improving perinatal outcomes and guiding clinical management. AI-assisted diagnostic tools can help clinicians interpret complex imaging data, reduce operator variability, and improve screening efficiency (Khalifa & Albadawy, 2024). Despite these promising technological developments, the integration of AI into prenatal diagnosis also raises significant ethical considerations. The early identification of fetal abnormalities may influence parental decision-making, psychological well-being, and clinical choices regarding pregnancy management (Shorey et al., 2023). As such, the growing role of AI in prenatal medicine requires careful ethical reflection beyond purely technical and clinical perspectives.

Within the Islamic intellectual tradition, medical knowledge and healthcare innovation are generally encouraged as part of the broader obligation to preserve human well-being. The Qur'an emphasizes the importance of protecting human life, as reflected in the verse: *"And whoever saves one life it is as if he had saved mankind entirely"* (Qur'an 5:32). This principle highlights the moral responsibility to utilize knowledge and technology in ways that support the preservation and protection of life. Similarly, the objectives of Islamic law (*Maqāṣid al-Sharīʿah*) emphasize the preservation of essential human values, including life (*ḥifẓ al-nafs*) and lineage (*ḥifẓ al-nasl*), both of which are closely related to maternal and fetal healthcare. Prophetic traditions also encourage the pursuit of knowledge and medical treatment. The Prophet Muhammad ﷺ stated: *"Seek treatment, for Allah has not created a disease except that He has also created its cure"* (Reported by Abu Dawud and al-Tirmidhi). This hadith reflects the Islamic encouragement of scientific and medical efforts aimed at improving human health and alleviating suffering. In this context, modern technologies such as artificial intelligence can be understood as potential tools that assist medical professionals in fulfilling their responsibility to protect life and promote well-being.

Nevertheless, the adoption of advanced technologies in prenatal diagnosis must also be approached with ethical awareness. While AI offers powerful capabilities for detecting fetal abnormalities, it also raises questions regarding medical responsibility, the interpretation of predictive information, and the broader moral implications of early prenatal knowledge. From an Islamic perspective, technological advancement

should be guided by ethical principles that ensure respect for human dignity, compassion in healthcare, and responsible decision-making.

Therefore, this paper aims to examine the development and application of artificial intelligence in prenatal diagnosis and to explore its ethical implications from an Islamic perspective. By integrating insights from medical science and Islamic ethical principles, the study seeks to highlight how emerging healthcare technologies can be responsibly utilized while remaining aligned with the moral values embedded within the Islamic tradition. This study employs a narrative literature review approach to examine existing research on AI-assisted prenatal diagnosis and analyze its ethical implications within the framework of Islamic bioethics.

Development of Artificial Intelligence in Medical Imaging

The integration of artificial intelligence (AI) into medical imaging represents one of the most significant technological transformations in contemporary healthcare. AI systems, particularly those based on machine learning (ML) and deep learning (DL), have demonstrated remarkable capabilities in analyzing complex medical images, assisting clinicians in disease detection, and improving diagnostic efficiency (Kumar et al., 2023). In radiology and ultrasound imaging, AI algorithms are increasingly used to perform tasks such as image classification, segmentation, anomaly detection, and clinical decision support.

Before the emergence of deep learning, medical image analysis relied primarily on traditional machine learning techniques that utilized manually engineered features. These approaches involved extracting texture, shape, and intensity characteristics from images and using classifiers such as Support Vector Machines, Random Forests, and k-Nearest Neighbors to differentiate between normal and pathological patterns. While these methods achieved moderate success, their performance was often limited by the quality of feature design and their inability to generalize across diverse imaging conditions (Singh et al., 2022).

The development of deep learning, particularly convolutional neural networks (CNNs), marked a major breakthrough in medical image analysis. Unlike traditional ML models, CNNs automatically learn hierarchical features directly from raw image data, enabling them to detect complex visual patterns with high accuracy. Architectures such as U-Net, ResNet, and DenseNet have been widely adopted for medical imaging tasks including tumor detection, organ segmentation, and disease classification. These models have significantly improved the ability of clinicians to analyze large volumes of imaging data and identify subtle abnormalities that may not be easily detected through manual interpretation alone (Siddique et al., 2021). Deep learning techniques, especially convolutional neural networks (CNNs), have become widely adopted in medical image analysis due to their ability to automatically extract complex features from imaging data (Shoaib et al., 2023).

In ultrasound imaging specifically, AI-based approaches have proven particularly valuable due to the inherent challenges associated with ultrasound interpretation (Drukker et al., 2020). Ultrasound images often contain speckle noise, variable image quality, and operator-dependent variations in acquisition. Deep learning models are capable of learning robust representations of anatomical

structures despite these challenges, allowing for more consistent and reliable diagnostic support. As a result, AI has been increasingly applied in various ultrasound domains, including breast imaging, thyroid assessment, cardiovascular analysis, and prenatal screening. Previous studies have demonstrated that machine learning and deep learning algorithms can be successfully applied to ultrasound imaging for automated disease classification (Latha et al., 2022).

The growing role of AI in medicine also resonates with the broader historical relationship between scientific inquiry and the Islamic intellectual tradition. Throughout history, Muslim scholars made significant contributions to medicine, pharmacology, and scientific methodology. One of the most prominent figures in this tradition is Ibn Sina, whose medical encyclopedia *The Canon of Medicine* served as a foundational reference for medical education in both the Islamic world and Europe for several centuries. His work emphasized systematic observation, clinical reasoning, and the ethical responsibility of physicians toward their patients.

The Islamic intellectual heritage consistently encouraged the pursuit of knowledge as a means of improving human well-being. Scientific advancement was not viewed as separate from religious values, but rather as a means of fulfilling the ethical responsibility to preserve life and alleviate suffering. In this context, contemporary technologies such as artificial intelligence can be understood as a continuation of this tradition of knowledge-driven healthcare innovation.

Nevertheless, while AI offers powerful capabilities for medical image analysis, its integration into healthcare must also be accompanied by ethical reflection (Hanna et al., 2025). The use of automated systems in clinical decision-making raises important questions regarding accountability, transparency, and the preservation of human-centered medical practice. These concerns become particularly significant in sensitive areas such as prenatal diagnosis, where medical information may have profound implications for families and society. For this reason, understanding the scientific development of AI in medical imaging is essential not only from a technological perspective but also from an ethical one.

Despite the rapid development of artificial intelligence in medical imaging and the growing body of research on AI-assisted prenatal diagnosis, much of the existing literature focuses primarily on technical performance, algorithm development, and clinical accuracy. While these studies provide valuable insights into the diagnostic capabilities of AI systems, relatively limited attention has been given to the broader ethical implications of applying such technologies in prenatal healthcare (Coghlan et al., 2023a). In particular, discussions that integrate technological advancements with religious and ethical perspectives remain scarce. Within the context of Islamic scholarship, ethical evaluation of emerging medical technologies is essential, especially when such technologies involve sensitive issues related to fetal development, parental decision-making, and the moral status of prenatal life. Therefore, there remains a need for interdisciplinary studies that examine AI-assisted prenatal diagnosis not only from a medical perspective but also through the lens of Islamic ethical principles. Therefore, this paper examines the development and application of artificial intelligence in prenatal diagnosis and explores its ethical

implications from an Islamic perspective, highlighting how Islamic ethical principles can guide the responsible use of emerging medical technologies.

Applications of Artificial Intelligence in Prenatal Diagnosis

Artificial intelligence has increasingly been applied in prenatal imaging to assist clinicians in detecting a wide range of fetal abnormalities. Advances in machine learning and deep learning algorithms have enabled automated analysis of ultrasound images, improving the accuracy and efficiency of prenatal screening. These technologies have been particularly useful in identifying abnormalities affecting the fetal heart, brain, skeletal system, and other organ structures. By assisting clinicians in analyzing complex imaging patterns, AI systems can support earlier diagnosis and potentially improve perinatal outcomes.

One of the most important areas of AI application in prenatal diagnosis is the detection of congenital heart defects (CHDs). CHDs represent one of the most common categories of fetal abnormalities and are associated with significant neonatal morbidity and mortality if not detected early (Akah et al., 2025). Deep learning models, particularly convolutional neural networks, have demonstrated strong performance in analyzing fetal echocardiographic images. These systems can assist in identifying standard cardiac views, segmenting anatomical structures, and detecting abnormalities such as septal defects or abnormal chamber formation. Some studies have reported diagnostic accuracies approaching 98% for certain categories of cardiac abnormalities. Despite these promising results, challenges remain in detecting rare or complex defects and in ensuring that models perform reliably across different patient populations and imaging conditions.

Artificial intelligence has also shown significant potential in detecting fetal brain abnormalities. Conditions such as neural tube defects, microcephaly, and ventriculomegaly may have profound consequences for fetal neurological development. Deep learning models have been developed to analyze ultrasound and magnetic resonance imaging data to identify structural abnormalities in the fetal brain. For example, convolutional neural networks and ensemble learning approaches have been used to detect variations in brain morphology and abnormal head circumference measurements with high levels of accuracy. Some studies report classification accuracies exceeding 90% in detecting specific neurological anomalies, demonstrating the potential of AI-assisted systems to complement conventional prenatal imaging techniques (Xie et al., 2020).

In addition to cardiac and neurological conditions, AI has been applied to the detection of skeletal and limb abnormalities. Abnormal skeletal development, including skeletal dysplasias and neuromuscular disorders, can significantly affect fetal growth and postnatal development. Machine learning models have been used to automatically measure long bones such as the femur and humerus from ultrasound images, providing more consistent and objective assessments of fetal biometry (Ghelich Oghli et al., 2021). Automated segmentation systems based on deep learning architectures have also enabled more accurate analysis of skeletal structures, improving the reliability of prenatal screening for growth abnormalities (Krawczyk & Starzyński, 2021).

Artificial intelligence applications in prenatal diagnosis also extend to other fetal structures and pregnancy-related conditions. For example, AI-based image analysis has been used to evaluate placental development and detect abnormalities associated with complications such as preeclampsia or fetal growth restriction. Similarly, machine learning models have been developed to analyze amniotic fluid volume, enabling automated detection of conditions such as oligohydramnios and polyhydramnios. These applications demonstrate the growing potential of AI to assist clinicians in monitoring various aspects of fetal health throughout pregnancy.

Despite the promising capabilities of AI-assisted prenatal diagnosis, several limitations remain. Many existing models are trained on relatively small or imbalanced datasets, which may affect their ability to generalize across diverse populations. Variability in ultrasound image quality and differences in scanning protocols can also influence model performance (Fiorentino et al., 2023). Furthermore, while AI systems can provide valuable diagnostic support, they are not intended to replace clinical expertise. Instead, they should be viewed as tools that assist healthcare professionals in interpreting complex imaging data and improving diagnostic consistency.

As artificial intelligence continues to evolve, its role in prenatal medicine is expected to expand further. However, the growing use of AI in detecting fetal abnormalities also raises important ethical considerations. Early diagnostic information may influence parental decision-making, clinical management, and broader societal attitudes toward prenatal health. These issues highlight the need to examine the ethical dimensions of AI-assisted prenatal diagnosis, particularly from perspectives that integrate both medical and moral considerations.

Ethical Challenges of AI-Based Prenatal Diagnosis

The integration of artificial intelligence into prenatal diagnosis presents significant opportunities for improving early detection of fetal abnormalities. However, alongside these technological advances arise a number of ethical challenges that require careful consideration. Prenatal diagnosis is not merely a technical medical procedure; it involves deeply personal decisions that affect families, healthcare professionals, and broader social perspectives on human life. When AI systems provide early or highly sensitive diagnostic information, the ethical implications of such knowledge become particularly significant.

One of the primary ethical concerns relates to the psychological and emotional impact on parents. Early detection of fetal abnormalities can create significant anxiety and uncertainty for expectant families (Oftedal et al., 2022). While AI-assisted systems may improve diagnostic accuracy, predictions generated by algorithms may still involve uncertainty or false positives. If such information is not communicated carefully by healthcare professionals, it may lead to unnecessary stress or premature conclusions regarding the health of the fetus. Consequently, AI technologies must be used in ways that support compassionate medical counselling rather than replacing human interaction in sensitive clinical contexts.

Another ethical issue concerns the reliability and accountability of AI-assisted medical decisions. Artificial intelligence systems rely on large datasets and complex

algorithms, yet their predictions may not always be fully transparent or explainable (Chaddad et al., 2023). In cases where an AI system produces an incorrect or misleading diagnosis, questions arise regarding responsibility. Medical practitioners remain ethically responsible for interpreting AI-generated results and ensuring that clinical decisions are based on comprehensive evaluation rather than automated outputs alone. Therefore, AI should function as a supportive tool rather than an autonomous decision-maker in prenatal healthcare.

From a broader societal perspective, the increasing use of advanced diagnostic technologies may also raise concerns about inequality in healthcare access. AI-based medical systems often require advanced computational infrastructure, specialized training, and well-curated datasets. These requirements may limit access to such technologies in resource-constrained settings, potentially widening disparities between healthcare systems in different regions (d'Elia et al., 2022). Ethical implementation of AI in medicine must therefore consider issues of fairness, accessibility, and equitable distribution of technological benefits.

Within the Islamic ethical framework, these concerns resonate with the broader objectives of the Maqasid al-Shariah. Islamic law emphasizes the protection of fundamental human values, including the preservation of life (*ḥifẓ al-nafs*) and the preservation of lineage (*ḥifẓ al-nasl*). Prenatal healthcare and fetal diagnosis can be understood as efforts to safeguard both maternal health and the well-being of future generations. From this perspective, medical technologies that enhance diagnostic capability may be viewed as tools that support these ethical objectives.

However, Islamic ethical thought also emphasizes that technological advancement must be guided by moral responsibility. The use of AI in prenatal medicine should not undermine the dignity of human life or reduce complex medical decisions to purely technological processes. Rather, such technologies should operate within a framework of ethical accountability, compassion, and respect for human dignity (Coghlan et al., 2023b). Healthcare professionals must therefore balance the benefits of technological innovation with careful ethical reflection grounded in both medical practice and moral principles.

Furthermore, Islamic teachings encourage the responsible pursuit of knowledge while reminding believers that ultimate knowledge belongs to God alone. The Qur'an states: *"And above every possessor of knowledge is one more knowing"* (Qur'an 12:76). This reminder highlights the importance of humility in scientific advancement. While AI may enhance human diagnostic capabilities, it does not eliminate uncertainty in medical knowledge. Recognizing these limits encourages a cautious and ethically responsible approach to the application of advanced technologies in prenatal healthcare.

In light of these considerations, the growing role of AI in prenatal diagnosis requires ethical frameworks that integrate scientific innovation with moral guidance. Islamic ethical principles offer valuable insights for evaluating the appropriate use of emerging medical technologies. By emphasizing the protection of life, the preservation of human dignity, and the responsible use of knowledge, Islamic ethics can contribute to a balanced and humane approach to AI-assisted prenatal medicine.

Islamic Ethical Perspectives on Prenatal Diagnosis

Advancements in prenatal diagnostic technologies, including artificial intelligence–assisted ultrasound analysis, raise important ethical questions concerning the status and protection of the fetus. Within the Islamic intellectual tradition, discussions surrounding prenatal life, fetal development, and medical intervention have long been addressed through the framework of Islamic jurisprudence and ethical reflection. These discussions are grounded in fundamental principles derived from the Qur'an, the Sunnah, and the broader objectives of Islamic law.

Islam places strong emphasis on the sanctity and protection of human life. The Qur'an highlights the moral value of preserving life in the verse: *"And whoever saves one life it is as if he had saved mankind entirely"* (Qur'an 5:32). This principle reflects the ethical obligation to pursue medical knowledge and healthcare practices that protect and enhance human well-being. In the context of prenatal medicine, technologies that assist in diagnosing fetal abnormalities may therefore be understood as tools that support the preservation of life by enabling early medical intervention, improved clinical monitoring, and better preparation for potential complications during pregnancy and childbirth.

The concept of fetal development in Islam is also discussed in classical Islamic scholarship through Prophetic traditions describing stages of embryological development. A well-known well-known hadiths narrated in Sahih al-Bukhari and Sahih Muslim, which describe the embryo developing in stages of forty days each: first as a drop (nutfah), then a clot ('alaqah), followed by a lump of flesh (mudghah). After these stages, the angel breathes the soul into the fetus, marking ensoulment (Mitra, 2021). This concept has played a central role in Islamic bioethical discussions concerning prenatal intervention and the moral status of the fetus.

The recognition of fetal development stages has significant implications for contemporary debates on prenatal diagnosis. Early detection of abnormalities through technologies such as AI-assisted ultrasound may provide valuable information that enables medical professionals and parents to prepare for appropriate treatment and care. Within the framework of the Maqasid al-Shariah, such medical efforts may contribute to the preservation of life (*ḥifẓ al-nafs*) and the protection of lineage (*ḥifẓ al-nasl*), both of which are fundamental objectives in Islamic ethical thought. Prenatal healthcare therefore represents an important aspect of safeguarding maternal and fetal well-being.

At the same time, Islamic ethics emphasizes that technological capabilities must be exercised within clear moral boundaries. Prenatal diagnosis should not lead to discriminatory attitudes toward individuals with disabilities or undermine the inherent dignity of human life (Huster, 2021). Rather, medical technologies should be used to support compassionate healthcare, informed medical counselling, and responsible decision-making by families and healthcare professionals. In this regard, Islamic ethical discourse encourages balancing medical knowledge with humility, moral responsibility, and respect for the sanctity of life.

Furthermore, Islamic teachings consistently encourage the pursuit of knowledge and medical treatment as part of human responsibility toward health and well-being. The Prophet Muhammad ﷺ stated: *"Seek treatment, for Allah has not created a*

disease except that He has also created its cure" (reported by Abu Dawud and al-Tirmidhi). This hadith underscores the legitimacy of medical research and technological innovation aimed at improving healthcare outcomes. In the context of modern medicine, artificial intelligence may therefore be viewed as an advanced tool that supports physicians in fulfilling their ethical duty to diagnose illness, prevent harm, and promote patient welfare.

Nevertheless, Islamic ethical thought also reminds believers that scientific knowledge remains limited and that ultimate knowledge belongs to God. Technological advancements should therefore be accompanied by humility and ethical awareness. AI-based diagnostic systems may provide powerful analytical capabilities, but they should not replace human judgement, compassion, and ethical responsibility in clinical decision-making. Instead, they should function as supportive tools that assist healthcare professionals in delivering more accurate and responsible medical care.

In light of these principles, Islamic ethics offers a valuable framework for evaluating emerging technologies in prenatal medicine. By emphasizing the protection of life, the responsible pursuit of knowledge, and the preservation of human dignity, Islamic teachings provide important guidance for ensuring that innovations such as artificial intelligence are used in ways that align with broader ethical and spiritual values.

Toward an Islamic Ethical Framework for AI-Assisted Prenatal Medicine

The increasing integration of artificial intelligence into prenatal healthcare highlights the need for ethical frameworks that guide the responsible use of emerging medical technologies (Dlugatch et al., 2023). While AI offers powerful tools for improving diagnostic accuracy and assisting clinicians in detecting fetal abnormalities, its implementation must be aligned with ethical principles that safeguard human dignity, protect life, and ensure responsible medical decision-making. From an Islamic perspective, ethical evaluation of new technologies can be informed by the broader objectives of the Maqasid al-Shariah, which emphasize the preservation of fundamental human values.

One of the central objectives within this framework is the preservation of life (*ḥifẓ al-nafs*). Prenatal diagnostic technologies, including AI-assisted imaging analysis, have the potential to contribute significantly to this objective by enabling earlier identification of fetal abnormalities and facilitating timely medical intervention. Early diagnosis can help healthcare professionals prepare appropriate treatment strategies, monitor high-risk pregnancies more effectively, and improve perinatal outcomes. When used responsibly, AI-based medical tools may therefore serve as instruments that support the ethical commitment within Islam to protect and preserve human life.

Another relevant objective of Islamic law is the preservation of lineage (*ḥifẓ al-nasl*), which emphasizes the protection of family integrity and the well-being of future generations. Prenatal healthcare plays an important role in safeguarding both maternal health and fetal development, and technological innovations that enhance diagnostic

capabilities can contribute to this objective. Artificial intelligence systems that assist clinicians in evaluating fetal growth, detecting congenital abnormalities, or monitoring pregnancy-related complications may therefore support broader efforts to protect the stability and health of families.

At the same time, Islamic ethical thought emphasizes that scientific knowledge must be exercised with moral responsibility. Classical scholars such as Abu Hamid al-Ghazali emphasized the importance of ethical intention and moral accountability in the pursuit of knowledge (Khairina Zahidah et al., 2025). Knowledge, in this view, is not merely a tool for technical advancement but also a means of fulfilling moral obligations toward society. In the context of modern medical technology, this perspective suggests that artificial intelligence should function as a supportive instrument that assists physicians rather than replacing human judgement in complex clinical decisions.

Similarly, the systematic articulation of the objectives of Islamic law by scholars such as Abu Ishaq al-Shatibi highlights the importance of balancing innovation with ethical safeguards (AL-RAYSUNI, 2005). Technological advancements should not undermine fundamental moral values or create harm within society. In prenatal medicine, this principle underscores the need for careful consideration of how diagnostic technologies are applied, ensuring that they contribute to compassionate healthcare rather than reducing medical decisions to purely technological processes.

Based on these considerations, several ethical principles may contribute toward an Islamic approach to AI-assisted prenatal medicine. First, artificial intelligence should be used primarily as a clinical support tool that enhances the ability of healthcare professionals to diagnose and manage medical conditions while maintaining human oversight in decision-making. Second, the implementation of AI technologies should prioritize patient dignity, ensuring that families receive clear communication, compassionate counselling, and appropriate medical guidance when diagnostic information is presented. Third, healthcare systems should ensure equitable access to technological innovations so that the benefits of advanced diagnostic tools are not limited to specific populations or regions.

Furthermore, transparency and accountability remain essential elements of ethically responsible AI systems (Cheong, 2024). Medical practitioners must understand the capabilities and limitations of AI algorithms and remain responsible for interpreting diagnostic results within the broader clinical context. This approach reflects the Islamic ethical emphasis on accountability (*mas'uliyyah*) in professional practice, particularly in fields that directly affect human life and well-being. Ultimately, the integration of artificial intelligence into prenatal medicine should be guided by a balanced approach that combines scientific innovation with ethical reflection. Islamic ethical principles provide valuable insights for navigating this evolving technological landscape. By emphasizing the preservation of life, the protection of lineage, the responsible pursuit of knowledge, and the importance of human dignity, Islamic thought offers a meaningful framework for evaluating the role of AI in contemporary healthcare.

Conclusion

Artificial intelligence is rapidly transforming the landscape of modern healthcare, particularly in the field of medical imaging. In prenatal medicine, AI-assisted ultrasound analysis offers promising capabilities for detecting fetal abnormalities, including congenital heart defects, neurological disorders, skeletal abnormalities, and pregnancy-related complications. By enhancing the ability of clinicians to interpret complex imaging data, these technologies may contribute to earlier diagnosis, improved clinical management, and better perinatal outcomes. However, despite these technological advances, the integration of AI into prenatal diagnosis also raises significant ethical considerations that extend beyond purely technical and clinical concerns.

The early detection of fetal abnormalities may influence parental decision-making, medical counselling, and broader societal attitudes toward prenatal health. As AI systems become increasingly involved in clinical workflows, questions related to diagnostic reliability, accountability, and the psychological impact of early diagnostic information become increasingly relevant. These issues highlight the importance of ensuring that technological innovation is accompanied by thoughtful ethical reflection.

From an Islamic perspective, emerging medical technologies can be evaluated through the ethical framework provided by the principles of the Maqasid al-Shariah, particularly the preservation of life (*ḥifẓ al-nafs*) and the preservation of lineage (*ḥifẓ al-nasl*). Prenatal healthcare, including the use of advanced diagnostic technologies, may therefore be understood as part of the broader ethical responsibility to protect human life and promote the well-being of future generations. At the same time, Islamic ethics emphasizes that scientific knowledge must be exercised with moral responsibility, compassion, and respect for human dignity.

In this context, artificial intelligence should be viewed not as a replacement for human medical judgement but as a supportive tool that enhances the ability of healthcare professionals to provide accurate and responsible care. The responsible integration of AI into prenatal medicine therefore requires a balanced approach that combines scientific innovation with ethical guidance. By engaging both contemporary medical developments and Islamic ethical principles, this study highlights the importance of developing thoughtful approaches that ensure technological progress remains aligned with broader moral and human values.

Acknowledgement

The authors would like to thank the Faculty of Science and Technology, Universiti Sains Islam Malaysia (USIM), for supporting the current study. This research was funded by the Ministry of Higher Education Malaysia (MOHE) under the Fundamental Research Grant Scheme for Early Career Researchers (FRGS-EC) (FRGS-EC/1/2024/SKK05/USIM/02/1).

Conflict of Interest Statements

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Authors' Contribution Statement

1. **Ahmad Luqmanulhakim Sunawari** contributed to the conceptualization of the study, development of the research methodology, validation of the findings, and the critical review and editing of the manuscript.
2. **Azira Khalil** was responsible for securing the research funding, supervising the overall research process, conducting analytical oversight, and providing critical review of the manuscript.
3. **Muhammad Roflee Waehama** contributed to the integration of the **Maqasid Shariah** framework and its analytical application within the study.

Ethics Statement

This article is a conceptual and theoretical analysis study based on existing literature sources. The study does not involve human participants, animal subjects, or the use of confidential data. Therefore, research ethics approval was not required. All references have been appropriately cited in accordance with the principles of academic integrity.

References

Akah, R. T., Enoh, J. E., & Nkeh-Chungag, B. (2025). The impact of early detection and intervention on congenital heart defects in infants and children: a systematic review. *Recent Advances in Natural Sciences*, 139. https://doi.org/10.61298/rans.2025.3.1.139

AL-RAYSUNI, A. (2005). *Imam Al Shatibi's Theory of the Higher Objectives and Intents of Islamic Law*. International Institute of Islamic Thought. https://doi.org/10.2307/j.ctvkjb1w9

Chaddad, A., Peng, J., Xu, J., & Bouridane, A. (2023). Survey of Explainable AI Techniques in Healthcare. *Sensors*, *23*(2), 634. https://doi.org/10.3390/s23020634

Cheong, B. C. (2024). Transparency and accountability in AI systems: safeguarding wellbeing in the age of algorithmic decision-making. *Frontiers in Human Dynamics*, *6*. https://doi.org/10.3389/fhumd.2024.1421273

Coghlan, S., Gyngell, C., & Vears, D. F. (2023a). Ethics of artificial intelligence in prenatal and pediatric genomic medicine. *Journal of Community Genetics*, *15*(1), 13–24. https://doi.org/10.1007/s12687-023-00678-4

Coghlan, S., Gyngell, C., & Vears, D. F. (2023b). Ethics of artificial intelligence in prenatal and pediatric genomic medicine. *Journal of Community Genetics*, *15*(1), 13–24. https://doi.org/10.1007/s12687-023-00678-4

d'Elia, A., Gabbay, M., Rodgers, S., Kierans, C., Jones, E., Durrani, I., Thomas, A., & Frith, L. (2022). Artificial intelligence and health inequities in primary care: a systematic scoping review and framework. *Family Medicine and Community Health*, *10*(Suppl 1), e001670. https://doi.org/10.1136/fmch-2022-001670

Dlugatch, R., Georgieva, A., & Kerasidou, A. (2023). Trustworthy artificial intelligence and ethical design: public perceptions of trustworthiness of an AI-based decision-support tool in the context of intrapartum care. *BMC Medical Ethics*, *24*(1), 42. https://doi.org/10.1186/s12910-023-00917-w

Drukker, L., Noble, J. A., & Papageorghiou, A. T. (2020). Introduction to artificial intelligence in ultrasound imaging in obstetrics and gynecology. *Ultrasound in Obstetrics & Gynecology*, *56*(4), 498–505. https://doi.org/10.1002/uog.22122

Fiorentino, M. C., Villani, F. P., Di Cosmo, M., Frontoni, E., & Moccia, S. (2023). A review on deep-learning algorithms for fetal ultrasound-image analysis. *Medical Image Analysis*, *83*, 102629. https://doi.org/10.1016/j.media.2022.102629

Ghelich Oghli, M., Shabanzadeh, A., Moradi, S., Sirjani, N., Gerami, R., Ghaderi, P., Sanei Taheri, M., Shiri, I., Arabi, H., & Zaidi, H. (2021). Automatic fetal biometry prediction using a novel deep convolutional network architecture. *Physica Medica*, *88*, 127–137. https://doi.org/10.1016/j.ejmp.2021.06.020

Hanna, M. G., Pantanowitz, L., Jackson, B., Palmer, O., Visweswaran, S., Pantanowitz, J., Deebajah, M., & Rashidi, H. H. (2025). Ethical and Bias Considerations in Artificial Intelligence/Machine Learning. *Modern Pathology*, *38*(3), 100686. https://doi.org/10.1016/j.modpat.2024.100686

He, F., Wang, Y., Xiu, Y., Zhang, Y., & Chen, L. (2021). Artificial Intelligence in Prenatal Ultrasound Diagnosis. *Frontiers in Medicine*, *8*. https://doi.org/10.3389/fmed.2021.729978

Huster, S. (2021). Non-invasive prenatal diagnostics (NIPD) in the system of medical care. Ethical and legal issues. *Journal of Perinatal Medicine*, *49*(8), 972–978. https://doi.org/10.1515/jpm-2021-0195

Khairina Zahidah, D., Norrodia, S., & Adawiyah, A. (2025). Al-Ghazali's Contribution to Islamic Scientific Ethics: Integration of Moral Values in Science Development. *ICONIS: International Conference on Islamic Studies*, *9*, 175–182. https://doi.org/10.19105/iconis.v9i1.951

Khalifa, M., & Albadawy, M. (2024). AI in diagnostic imaging: Revolutionising accuracy and efficiency. *Computer Methods and Programs in Biomedicine Update*, *5*, 100146. https://doi.org/10.1016/j.cmpbup.2024.100146

Krawczyk, Z., & Starzyński, J. (2021). Segmentation of bone structures with the use of deep learning techniques. *Bulletin of the Polish Academy of Sciences Technical Sciences*, 136751–136751. https://doi.org/10.24425/bpasts.2021.136751

Kumar, Y., Koul, A., Singla, R., & Ijaz, M. F. (2023). Artificial intelligence in disease diagnosis: a systematic literature review, synthesizing framework and future research agenda. *Journal of Ambient Intelligence and Humanized Computing*, *14*(7), 8459–8486. https://doi.org/10.1007/s12652-021-03612-z

Latha, S., Muthu, P., Lai, K. W., Khalil, A., & Dhanalakshmi, S. (2022). Performance Analysis of Machine Learning and Deep Learning Architectures on Early Stroke Detection Using Carotid Artery Ultrasound Images. *Frontiers in Aging Neuroscience*, *13*. https://doi.org/10.3389/fnagi.2021.828214

Mitra, P. (2021). The Beginning of Life Issues: An Islamic Perspective. *Journal of Religion and Health*, *60*(2), 663–683. https://doi.org/10.1007/s10943-020-01018-3

Oftedal, A., Bekkhus, M., Haugen, G. N., Czajkowski, N. O., & Kaasen, A. (2022). The impact of diagnosed fetal anomaly, diagnostic severity and prognostic ambiguity on parental depression and traumatic stress: a prospective longitudinal cohort study. *Acta Obstetricia et Gynecologica Scandinavica*, *101*(11), 1291–1299. https://doi.org/10.1111/aogs.14453

Shoaib, M. A., Chuah, J. H., Ali, R., Hasikin, K., Khalil, A., Hum, Y. C., Tee, Y. K., Dhanalakshmi, S., & Lai, K. W. (2023). An Overview of Deep Learning Methods for Left Ventricle Segmentation. *Computational Intelligence and Neuroscience*, *2023*(1). https://doi.org/10.1155/2023/4208231

Shorey, S., Lalor, J., Pereira, T. L., Jarašiūnaitė-Fedosejeva, G., & Downe, S. (2023). Decision-making and future pregnancies after a positive fetal anomaly screen: A scoping review. *Journal of Clinical Nursing*, *32*(17–18), 5534–5549. https://doi.org/10.1111/jocn.16628

Siddique, N., Paheding, S., Elkin, C. P., & Devabhaktuni, V. (2021). U-Net and Its Variants for Medical Image Segmentation: A Review of Theory and Applications. *IEEE Access*, *9*, 82031–82057. https://doi.org/10.1109/ACCESS.2021.3086020

Singh, H., Sharma, V., & Singh, D. (2022). Comparative analysis of proficiencies of various textures and geometric features in breast mass classification using k-nearest neighbor. *Visual Computing for Industry, Biomedicine, and Art*, *5*(1), 3. https://doi.org/10.1186/s42492-021-00100-1

Xie, H. N., Wang, N., He, M., Zhang, L. H., Cai, H. M., Xian, J. B., Lin, M. F., Zheng, J., & Yang, Y. Z. (2020). Using deep-learning algorithms to classify fetal brain ultrasound images as normal or abnormal. *Ultrasound in Obstetrics & Gynecology*, *56*(4), 579–587. https://doi.org/10.1002/uog.21967