(REVIEW ARTICLE)

Check for updates

Ethical considerations in implementing generative AI for healthcare supply chain optimization: A cross-country analysis across India, the United Kingdom, and the United States of America

Amina Catherine Ijiga [1, *], Ehi Peace Abutu [2], Idoko Peter Idoko [3], Daniel Obekpa Agbo [4], Kimberly D. Harry [5], Chijioke Ifakandu Ezebuka [6] and Esther Ene Umama [7]

[1] Department of International Relations and Diplomacy, Federal University of Lafia, Nasarawa, Nigeria.
[2] Department of Surgical Nursing, The Jamil Nadu Dr. M.G.R. Medical University, Guindy, Chennai, India.
[3] Department of Electrical & Electronics Engineering, University of Ibadan, Ibadan, Nigeria.
[4] Department of Technical Communication, Missouri University of Science and Technology, Rolla, USA.
[5] Department of Systems Science and Industrial Engineering, Binghamton University, New York, USA.
[6] Department of Information Technology, Jonsson Workwear Pty Ltd, Durban, South Africa.
[7] School of Nursing and Midwifery, University of University of Birmingham, Birmingham, United Kingdom.

Abstract

This review paper critically examines the ethical considerations involved in implementing generative Artificial Intelligence (AI) in healthcare supply chain optimization across three distinct regions: India, the United Kingdom, and the United States of America. The study synthesizes findings from various case studies and academic research to highlight both common and unique ethical challenges faced in these countries. Key themes such as data privacy, algorithmic transparency, and equitable access to AI-driven healthcare solutions are explored, alongside the unique socio-cultural, legal, and regulatory challenges specific to each region.

The paper proposes a set of best practices for incorporating ethical considerations into the deployment of generative AI in healthcare. These include the development of inclusive ethical frameworks, regular ethical audits, comprehensive training and education programs, public engagement initiatives, and interdisciplinary collaboration. The paper also delves into future research directions and policy development, emphasizing the need to address healthcare disparities, adapt legal and regulatory frameworks, enhance generative AI explainability, and evaluate long-term outcomes.

The study concludes by underscoring the importance of ethical design and deployment of generative AI systems in healthcare, advocating for a balanced approach that aligns technological advancements with ethical standards and global healthcare needs. This comprehensive review aims to contribute to the discourse on ethical generative AI implementation, offering insights and recommendations for policymakers, healthcare professionals, and generative AI developers to foster responsible and beneficial use of generative AI in healthcare globally.

Keywords: Generative AI; Healthcare Supply Chain; Ethical Considerations; Cross-Country Analysis; AI Implementation; Healthcare Technology; India; UK; USA

---

* Corresponding author: Amina Catherine Ijiga

1. Introduction

1.1. Overview of Generative AI in Healthcare Supply Chain Optimization

The integration of Generative Artificial Intelligence (AI) in healthcare supply chain optimization represents a significant leap forward in the management and distribution of healthcare resources see figure 1. Generative AI, particularly in the form of large language models (LLMs) like ChatGPT, has shown immense potential in revolutionizing data and information management within the healthcare sector (Yu, Xu, Hu, & Deng, 2023). These advanced AI systems, characterized by their ability to generate new data and insights, are increasingly being leveraged to enhance various aspects of the healthcare supply chain, from inventory management to demand forecasting.
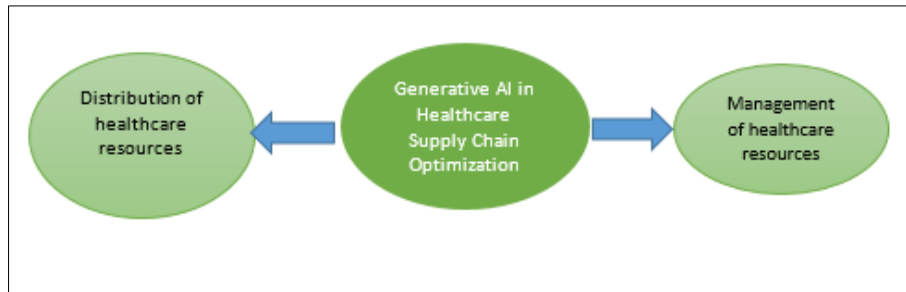

Figure 1 Generative AI in Healthcare Supply Chain Optimization

The capabilities of generative AI extend beyond traditional data processing, offering innovative solutions for complex supply chain challenges. For instance, generative AI-driven predictive analytics can forecast supply needs, optimize inventory levels, and even assist in strategic decision-making processes. This technological advancement is not just about efficiency; it's about redefining the way healthcare providers anticipate and meet patient needs (Hao & Demir, 2023).

1.1.1. Significance of Ethical Considerations in Implementation generative AI in Healthcare Supply Chain

As generative AI continues to permeate the healthcare supply chain, ethical considerations have emerged as a critical aspect of its implementation. The ethical landscape surrounding generative AI in healthcare is multifaceted, encompassing issues related to data privacy, security, and the potential for bias in AI-generated decisions (Ning et al., 2023). These concerns are not merely theoretical; they have practical implications that can affect patient care and the overall integrity of healthcare systems.

The ethical deployment of generative AI in healthcare supply chains necessitates a comprehensive understanding of these challenges. It involves navigating the fine line between leveraging generative AI's capabilities for improved healthcare delivery and ensuring that these technologies are used responsibly and ethically. This balance is crucial in maintaining public trust and ensuring that generative AI-driven innovations genuinely benefit patients and healthcare providers alike.

In addressing these ethical challenges, it is essential to consider the development and adherence to robust ethical frameworks and guidelines. Such frameworks should not only comply with existing regulations but also anticipate future ethical dilemmas that may arise from the evolving capabilities of generative AI. The creation of an ethics checklist, as proposed by Ning et al. (2023), is a step towards ensuring a comprehensive assessment and transparent documentation of ethical considerations in generative AI development within healthcare.

The integration of generative AI into healthcare supply chain optimization presents both remarkable opportunities and significant ethical challenges. As this technology continues to evolve, it is imperative to maintain a vigilant and proactive approach to its ethical implementation, ensuring that the benefits of generative AI are realized without compromising ethical standards and patient trust.

1.2. Purpose of the Review

The purpose of this review is twofold: to underscore the importance of ethical considerations in the implementation of generative AI within healthcare supply chains and to conduct a cross-country analysis, focusing on India, the United

Kingdom, and the United States. This dual focus is essential in understanding the global impact of generative AI and the diverse ethical landscapes it navigates.

1.2.1. Highlighting the Importance of Ethical Considerations

The rapid advancement and integration of generative AI in healthcare supply chain optimization necessitates a thorough examination of the ethical implications associated with its use. As generative AI technologies become more sophisticated, they bring forth complex ethical challenges that must be addressed to ensure responsible and beneficial implementation. These challenges include, but are not limited to, issues of data privacy, algorithmic bias, and the potential for unintended consequences in patient care and resource allocation (Ning et al., 2023).

Understanding and addressing these ethical considerations is not merely a regulatory compliance issue; it is a fundamental aspect of ensuring that generative AI technologies serve the greater good in healthcare. This review aims to highlight the critical nature of these ethical considerations, emphasizing the need for a proactive approach in integrating ethical frameworks and guidelines into generative AI development and deployment in healthcare supply chains.

1.2.2. Cross-Country Analysis of Generative AI across India, the United Kingdom, and the United States

The second aim of this review is to provide a cross-country analysis, exploring how different countries, with their unique regulatory environments and cultural contexts, approach the ethical implementation of generative AI in healthcare supply chains. This comparative analysis will focus on India, the United Kingdom, and the United States, offering insights into the diverse strategies and challenges faced by these nations.

Each country presents a unique case in terms of its technological capabilities, regulatory frameworks, and ethical considerations. For instance, the regulatory environment in the United States may differ significantly from that in India or the United Kingdom, leading to different approaches in addressing ethical concerns (Hao & Demir, 2023). Similarly, cultural and societal values play a crucial role in shaping the ethical landscape of AI implementation in healthcare. By examining these differences and similarities, the review aims to provide a comprehensive understanding of the global ethical considerations in generative AI deployment in healthcare supply chains.

This review seeks to contribute to the broader discourse on ethical generative AI implementation by providing a detailed examination of the challenges and considerations specific to the healthcare supply chain context. Through this analysis, it aims to offer valuable insights for policymakers, healthcare professionals, and generative AI developers, fostering a more ethically informed and globally aware approach to the integration of generative AI in healthcare systems. This endeavor is not only crucial for ensuring ethical compliance but also for harnessing the full potential of generative AI technologies in improving healthcare outcomes across different regions and cultures.

1.3. Organization of the article

The remainder of this research article is organized as follows: Section 2 delves into generative AI in healthcare supply chain optimization. Section 3 explores ethical frameworks in generative AI in healthcare supply chain optimization in India, the United Kingdom, and the United States, providing a comprehensive cross-country analysis. Section 4 presents a detailed examination of Cross-Country Analysis of generative AI landscape in India, UK and USA. The conclusion of the research, summarizing the key findings and offering final thoughts on the ethical landscape of implementing generative AI in healthcare supply chain optimization across different countries, is presented in Section 5.

2. Generative AI in healthcare supply chain optimization

2.1. Overview of Generative AI

Generative AI has emerged as a transformative force in the healthcare sector, particularly in optimizing supply chain management. This technology, characterized by its ability to generate new data and insights, is reshaping how healthcare providers manage resources, predict demands, and maintain efficient operations.

2.1.1. Definition and Capabilities of Generative AI

Generative AI refers to a subset of AI technologies that can create new content, data, or solutions based on learned patterns and information. In healthcare, this includes applications ranging from medical imaging analysis to drug discovery and supply chain optimization (Shokrollahi et al., 2023). These AI models, particularly transformers and

diffusion models, have shown remarkable proficiency in handling diverse forms of data, thereby enhancing clinical diagnosis, data reconstruction, and drug synthesis.

The capabilities of generative AI extend to analyzing complex datasets, predicting trends in healthcare demands, and optimizing logistics and inventory management. For instance, generative AI-driven predictive analytics can forecast supply needs, streamline inventory levels, and assist in strategic decision-making processes, significantly improving the efficiency and responsiveness of healthcare supply chains (Painuly, Sharma, & Matta, 2023).

2.1.2. Applications Generative AI in Healthcare Supply Chain Optimization

In the realm of healthcare supply chain management, generative AI has been instrumental in addressing some of the most pressing challenges. One of the key applications is in the management of medical supplies and equipment, where generative AI systems analyze vast amounts of data to create integrated, efficient, and agile supply chain solutions. This not only ensures the availability of essential medical resources but also contributes to cost reduction and waste minimization (Painuly, Sharma, & Matta, 2023).

Another significant application is in the field of medical imaging, where generative AI models enhance image reconstruction, classification, and translation. This capability is crucial in diagnostic processes and treatment planning, directly impacting patient care quality (Shokrollahi et al., 2023).

Furthermore, generative AI has found applications in clinical documentation, diagnostic assistance, and even in the complex process of drug design and molecular representation. These advancements are not just technological feats; they represent a paradigm shift in how healthcare providers approach and manage the supply chain, from the procurement of resources to the delivery of patient care (Zhang & Boulos, 2023).

The integration of generative AI into healthcare supply chain optimization presents a landscape brimming with opportunities and challenges. As this technology continues to evolve, it is imperative to maintain a vigilant and proactive approach to its implementation, ensuring that the benefits of generative AI are realized without compromising ethical standards and patient trust. 2.2. Current Trends and Adoption

The current landscape of generative AI in healthcare supply chain optimization is marked by rapid advancements and increasing adoption across various segments of the industry. This trend reflects a growing recognition of the potential benefits that generative AI technologies offer in enhancing efficiency, accuracy, and overall effectiveness in managing healthcare resources.

2.1.3. Examples of Generative AI Implementation in Healthcare Supply Chains

One of the most notable trends in the adoption of generative AI is its application in e-healthcare supply chain management systems. Healthcare organizations are increasingly utilizing generative AI to manage vast amounts of data required for creating integrated and agile supply chains. This includes the acquisition and distribution of medical supplies, storage of vital medications, and scheduling of patient treatments (Painuly, Sharma, & Matta, 2023). Generative AI's ability to swiftly analyze and intelligently process large datasets is crucial in these contexts, enabling healthcare providers to respond more effectively to patient needs and operational demands.

In the pharmaceutical industry, generative AI technology is revolutionizing supply chain management by optimizing logistics and production processes. Leading pharmaceutical companies such as Pfizer, Amgen, and GlaxoSmithKline are leveraging generative AI-powered solutions to enhance the accuracy and efficiency of their supply chain management. This not only reduces costs but also ensures compliance with regulatory requirements, thereby improving product quality and patient safety (Guo, 2023).

2.1.4. Potential Benefits and Challenges of Generative AI in Healthcare Supply Chain

The benefits of implementing generative AI in healthcare supply chains are manifold. Generative AI technologies enhance the precision and speed of supply chain operations, leading to significant improvements in resource allocation and inventory management. This, in turn, contributes to cost reductions and better patient outcomes. Additionally, generative AI-driven solutions in supply chain management facilitate compliance with complex regulatory environments, a critical aspect in the healthcare sector (Guo, 2023).

However, the adoption of generative AI in healthcare supply chains is not without challenges. One of the primary concerns is the need to balance the hype surrounding generative AI technologies with realistic expectations. While

generative AI offers substantial benefits, it is crucial to demystify inflated expectations and focus on tangible outcomes (Dijmărescu, 2023). Moreover, the implementation of generative AI in healthcare supply chains must address security and privacy issues, ensuring that patient data is protected and that generative AI systems operate within ethical boundaries.

The current trends in the adoption of generative AI in healthcare supply chains highlight a dynamic and evolving landscape. As these technologies continue to advance, they offer significant opportunities to enhance the efficiency and effectiveness of healthcare operations. However, it is essential to navigate the challenges associated with generative AI implementation thoughtfully, ensuring that the benefits are realized in a responsible and sustainable manner.

3. Ethical frameworks in generative AI

3.1. Introduction to Ethical Considerations in Generative AI

In the dynamic intersection of technology and healthcare supply chain, the advent of Generative AI introduces a transformative wave with profound ethical implications. As artificial intelligence increasingly shapes decision-making processes, it becomes imperative to scrutinize the ethical considerations embedded in generative AI applications within the healthcare supply chain. This multifaceted exploration delves into the responsible use of generative AI, addressing issues such as data privacy, algorithmic bias, and transparency. Striking a delicate balance between innovation and ethical safeguards is paramount to fostering trust in generative AI-driven solutions and ensuring equitable access to healthcare resources. This introduction sets the stage for an insightful examination of the ethical considerations surrounding Generative AI in the context of healthcare supply chain management.

3.1.1. Key Ethical Concerns in Generative AI Applications in Healthcare supply chain

Key Ethical Considerations in Generative AI Applications within the healthcare sector present a mosaic of critical concerns that merit careful examination. Foremost among these is the ethical responsibility of medical institutions in integrating AI into medical education. This entails ensuring the accuracy of AI-generated information, addressing potential biases embedded in AI algorithms, and evaluating the broader ramifications for student learning and patient care (Busch, Adams, & Bressem, 2023).

Additionally, compliance with data protection regulations, notably the European General Data Protection Regulation (GDPR), emerges as a central ethical challenge. Given the involvement of AI applications in healthcare data, stringent adherence to privacy and security standards becomes imperative. Ethical considerations extend to the stages of data collection and decision-making, emphasizing transparency and accountability within generative AI systems (MohammadAmini et al., 2023). Furthermore, issues of equity in access, algorithmic accountability, and long-term societal impact constitute integral dimensions of ethical scrutiny in the deployment of generative AI in healthcare. Table 1 shows a summary of ethical consideration of generative AI in healthcare applications as well as their descriptions and key concerns.

Table 1 Ethical considerations, descriptions, and key concerns in Generative AI Healthcare

Ethical Considerations	Description	Key Concerns
Accuracy of AI-generated information	Ensuring the precision and reliability of information produced by AI in medical education.	Educational Impact, Information Quality
Potential Bias in AI Algorithms	Addressing and mitigating biases embedded in AI algorithms used in healthcare.	Algorithmic Fairness, Bias Mitigation
Implications for Student Learning	Examining the broader impact of AI on the educational experience of medical students.	Learning Enhancement, Educational Equity
Implications for Patient Care	Assessing how AI applications influence and shape the quality of patient care.	Healthcare Quality, Patient Outcomes
Compliance with GDPR	Adhering to data protection regulations, specifically focusing on patient data privacy.	Data Privacy, GDPR Compliance

3.1.2. Relevance to Healthcare Supply Chain Optimization

In the context of healthcare supply chain optimization, ethical considerations revolve around the use of generative AI for decision-making processes that directly affect patient care and resource allocation. Ethical principles such as respect for person, accountability, and sustainability are crucial in this regard. These principles pertain to the domains of data acquisition, clinical setting, and social environment, ensuring that AI applications in healthcare supply chains are aligned with ethical standards and societal values (Moon et al., 2023).

The ethical use of AI in healthcare supply chains also involves addressing the 'black box' problem, where the decision-making process of AI systems is not transparent. This lack of transparency can lead to ethical dilemmas, particularly when generative AI-driven decisions have significant implications for patient care and resource distribution. Ensuring explainability and accountability in generative AI systems is therefore a key ethical consideration in their application to healthcare supply chains.

The ethical considerations in the application of generative AI in healthcare, including its use in supply chain optimization, are multifaceted and complex. Addressing these considerations requires a comprehensive approach that encompasses respect for privacy, adherence to regulatory standards, transparency in generative AI decision-making processes, and the alignment of generative AI applications with societal values and ethical norms.

3.2. Existing Ethical Frameworks

The integration of generative AI in healthcare necessitates the adoption of ethical frameworks that guide its development and application. This frame work is shown in figure 2. These frameworks are essential in ensuring that generative AI technologies align with human values and ethics, particularly in a field as sensitive as healthcare.
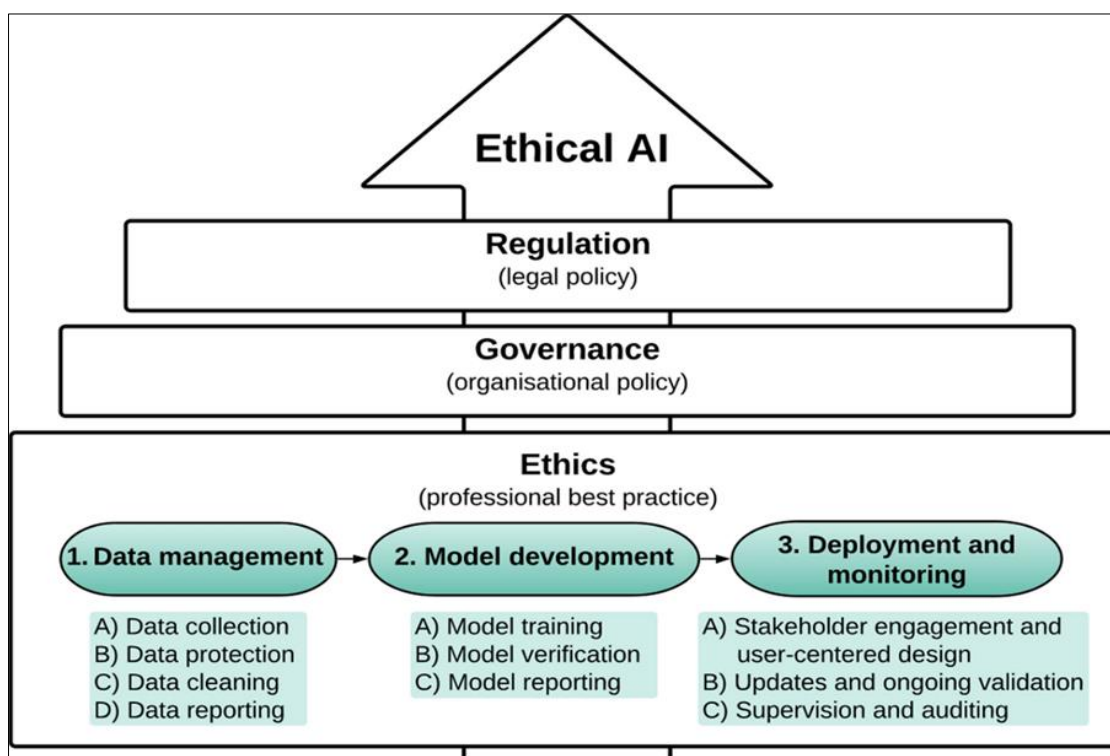

Figure 2 Ethical framework of generative AI applications (Solanki et. al., 2023)

3.2.1. Overview of Established Ethical Guidelines in Generative AI

Several ethical guidelines and frameworks have been proposed to address the unique challenges posed by generative AI in healthcare. Solanki, Grundy, and Hussain (2022) emphasize the importance of operationalizing ethics in generative AI for healthcare. They propose a solution-based framework that spans the entire generative AI lifecycle, including data management, model development, deployment, and monitoring. This framework is designed to empower generative AI developers with actionable solutions that ensure adherence to ethical practices in their daily work.

Amugongo, Kriebitz, Boch, and Lütge (2023) advocate for a shift from general ethical principles to contextualized, case-based ethical frameworks. They propose integrating ethical principles throughout the generative AI development pipeline, particularly in agile software development processes. This approach ensures that ethical considerations are not an afterthought but are embedded from the beginning of the development process.

3.2.2. Applicability to the Healthcare Sector

In the healthcare sector, the application of these ethical frameworks is crucial in balancing the potential benefits of generative AI solutions against the risks to patients and the wider community. Peters, Vold, Robinson, and Calvo (2020) describe two frameworks for integrating ethical analysis into engineering practice, specifically in the context of digital healthcare. These frameworks focus on addressing ethical issues in the design of autonomous and intelligent systems, including generative AI applications in healthcare.

The ethical frameworks in generative AI for healthcare address various concerns such as patient confidentiality, data privacy, and the potential for exacerbating inequalities among minority groups. They also emphasize the need for transparency and accountability in generative AI systems, particularly in clinical decision support and patient care applications.

The existing ethical frameworks in generative AI applicable to healthcare provide a comprehensive guide for developers and practitioners. These frameworks ensure that generative AI technologies in healthcare are developed and implemented in a manner that respects human values, adheres to ethical standards, and prioritizes patient safety and well-being.

4. Cross-country analysis

4.1. India

4.1.1. Ethical Landscape of Generative AI Implementation

The ethical landscape of generative AI implementation in healthcare in India is a complex interplay of advancing technology, cultural values, and regulatory challenges as seen in figure 3 below. Jain and Chowdhury (2019) highlight that while India has made strides in healthcare, the integration of AI raises ethical questions, particularly in relation to global health ethics. The principles of global health ethics, such as equity, justice, and respect for autonomy, are crucial in guiding the ethical implementation of generative AI in healthcare. However, there is a need for these principles to be more explicitly considered in national healthcare policies to ensure equitable health outcomes.
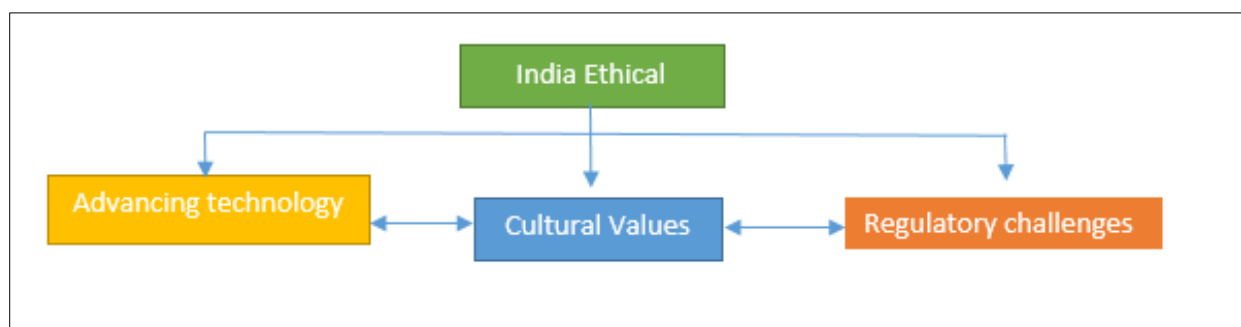

Figure 3 Ethical Landscape of Generative AI in India

Kalyanakrishnan et al. (2018) discuss the potential of generative AI as a catalyst for progress in India, particularly in healthcare. However, they also note the risks associated with generative AI, including exacerbating existing inequalities and compromising patient confidentiality. The ethical implementation of generative AI in healthcare in India requires a careful balance between leveraging technological advancements and mitigating these risks.

Sethi et al. (2022) explore the ethical vulnerability in generative AI, emphasizing the importance of knowledge management in addressing these challenges. They suggest that fields like healthcare are prime areas where ethical considerations in generative AI implementation are crucial. The focus should be on developing generative AI applications that are not only technologically advanced but also ethically sound and culturally sensitive.

4.1.2. Regulatory Environment and Guidelines

The regulatory environment in India for generative AI in healthcare is evolving. The lack of specific guidelines and policies for generative AI ethics in healthcare poses a challenge. However, there is an increasing awareness of the need for such regulations. Jain and Chowdhury (2019) argue for the importance of incorporating global health ethics into national policy-making to ensure just and equitable healthcare outcomes.

Kalyanakrishnan et al. (2018) suggest that India's approach to generative AI in healthcare should include mechanisms to address ethical concerns from the outset. This involves creating frameworks that not only encourage innovation but also ensure that generative AI applications are developed and used responsibly.

Sethi et al. (2022) highlight the need for ethical guidelines that specifically address the vulnerabilities and challenges posed by generative AI in healthcare. These guidelines should focus on ensuring patient privacy, data security, and equitable access to generative AI-driven healthcare solutions.

The ethical landscape of generative AI implementation in healthcare in India is marked by opportunities for advancement and challenges in ensuring equitable and ethical use of technology. The development of comprehensive regulatory frameworks and guidelines, grounded in global health ethics and tailored to India's unique socio-cultural context, is essential for the responsible integration of generative AI in healthcare.

4.2. United Kingdom

4.2.1. Ethical Considerations of Generative AI Specific to the UK

The United Kingdom (UK) presents a unique context for the ethical considerations of generative AI in healthcare. Drabiak, Kyzer, Nemov, and El Naqa (2023) discuss the ethical challenges and concerns in the UK, particularly regarding patient privacy, legal responsibility, trustworthiness, and fairness in AI and machine learning (ML) applications. The UK's approach to generative AI in healthcare emphasizes the need for developers to demonstrate that AI functions as intended and to adopt strategies that minimize risks of failure or bias. This includes ensuring transparency in AI/ML algorithms and protecting patient well-being. Figure 4 summarizes the ethical considerations of generative AI in UK.

Li, Williams, Gilbert, and Anderson (2023) highlight the regulatory challenges in the UK, especially concerning generative AI and ML-enabled medical devices. The typical development process of AI through learning and implementation cycles poses challenges to the existing system of regulating medical devices. The UK faces the task of balancing the benefits of continuous improvement of generative AI algorithms with the need to assure safety. Governance and assurance processes in the UK are evolving to accommodate real-time or near-real-time machine learning, emphasizing the importance of ethical principles being integrated throughout the entire AI development pipeline.
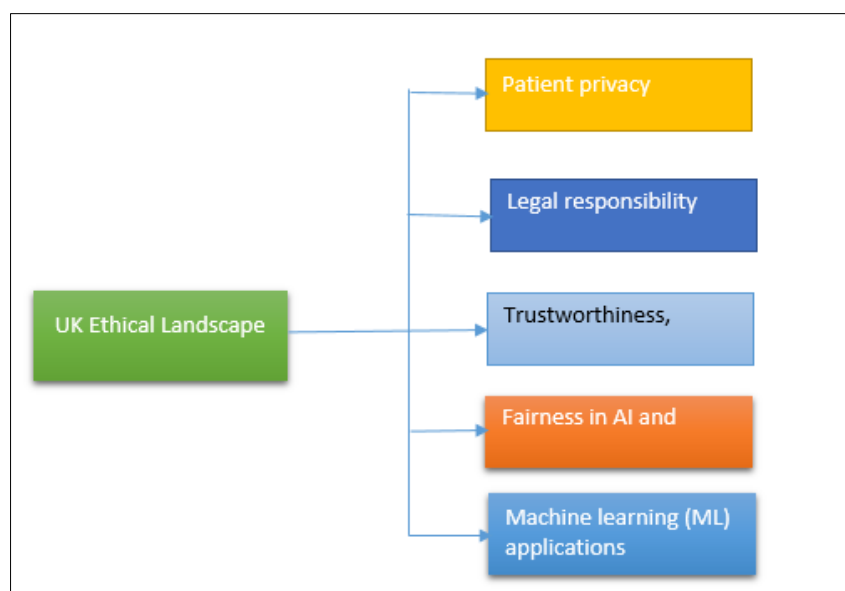

Figure 4 Ethical Landscape of Generative AI in UK

Mclean's work on ethics and healthcare in the UK provides a broader view of the ethical landscape in healthcare. It underscores the need for ethical considerations to be deeply embedded in healthcare practices, including the use of generative AI technologies. The UK's approach to healthcare ethics, particularly in the context of generative AI, involves scrutinizing the impact of generative AI on healthcare relationships and ensuring that the development and deployment of generative AI are aligned with the fundamental principles of medical ethics.

4.2.2. Legal and Regulatory Framework

The legal and regulatory framework in the UK for generative AI in healthcare is characterized by an effort to adapt to the rapid advancements in generative AI and ML technologies. Drabiak et al. (2023) note the importance of regulatory and legal issues applicable in Europe and the United States, which also influence the UK's approach. The UK's regulatory trajectory shows signs of alignment with international models, particularly in terms of ensuring the safety and efficacy of generative AI-enabled medical devices.

Li et al. (2023) discuss the UK's attempts to adapt laws for generative AI-enabled medical devices (AIeMD), with a focus on regulatory proposals both in the UK and internationally. The UK's regulatory framework is evolving to address the unique challenges posed by generative AI in healthcare, including issues related to data protection, patient safety, and ethical deployment of generative AI technologies.

The ethical considerations specific to the UK in generative AI implementation in healthcare involve a complex interplay of ethical challenges, regulatory adaptations, and the need for a balanced approach to innovation and safety. The UK's legal and regulatory framework is evolving to keep pace with technological advancements, ensuring that generative AI in healthcare is developed and used in a manner that is ethical, safe, and beneficial to patients.

4.3. United States of America

4.3.1. Ethical Considerations in the US Context

The ethical landscape of Artificial Intelligence (AI) implementation in healthcare in the United States is shaped by a diverse set of challenges and considerations. Drabiak, Kyzer, Nemov, and El Naqa (2023) discuss the ethical challenges in the US, particularly regarding patient privacy, legal responsibility, trustworthiness, and fairness in generative AI and machine learning (ML) applications. The US approach emphasizes the need for generative AI developers to ensure that generative AI functions as intended and to adopt strategies that minimize risks for failure or bias. This includes promoting transparency in generative AI/ML algorithms and protecting patient well-being.

Taiwo, Akinsola, Tella, Makinde, and Akinwande (2023) highlight the impact of generative AI across various sectors in the US, including healthcare. They emphasize the need for ethical considerations as entities increasingly depend on generative AI for crucial tasks that influence operations, decision-making, and interactions. The adoption of ethical principles, guidelines, and standards of work is required throughout the entire process of generative AI development, deployment, and usage to ensure responsible and ethical generative AI practices.
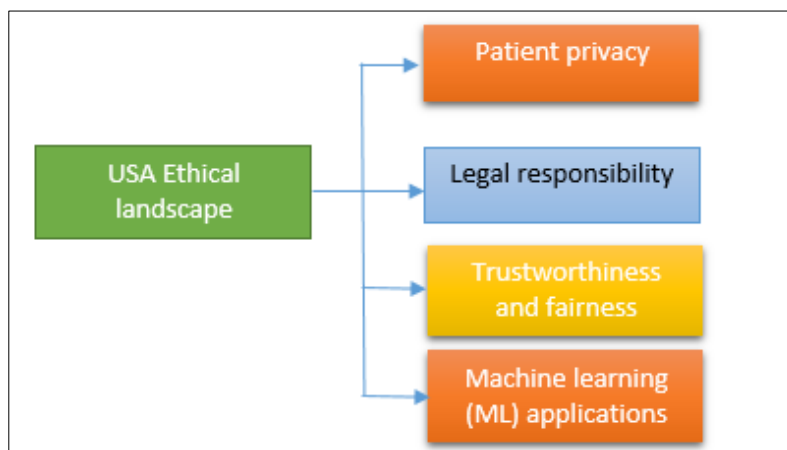

Figure 5 Ethical Landscape of Generative AI in USA

Baric-Parker and Anderson (2020) address the ethical and social challenges of collaborations between healthcare systems and technology companies for developing generative AI applications, particularly in the context of sharing electronic health record (EHR) data. They discuss threats to patient privacy and confidentiality, undermining of patient consent, and lack of corporate transparency.

The article suggests that ethical guidelines, such as the United States Catholic Conference of Bishops' Ethical and Religious Directives, should be updated to address data-sharing and generative AI more directly. The summary of the ethical consideration of generative AI in USA is summarized in figure 5.

4.3.2. Regulatory Landscape and Policies

The regulatory landscape in the US for generative AI in healthcare involves navigating the balance between innovation and ethical considerations. Drabiak et al. (2023) provide an overview of regulatory and legal issues applicable in the US, emphasizing the need for trustworthy generative AI/ML that promotes transparency, minimizes risks of bias or error, and protects patient well-being.

Taiwo et al. (2023) discuss the revolutionary impact of generative AI applications, such as machine learning, and explore various approaches used to implement generative AI ethics in the US. They suggest that ethical principles should be integrated into the software development processes commonly used by developers.

Baric-Parker and Anderson (2020) highlight the need for governance and assurance processes that can accommodate real-time or near-real-time machine learning in healthcare. They suggest that the US regulatory framework should evolve to address the unique challenges posed by generative AI in healthcare, including issues related to data protection, patient safety, and ethical deployment of generative AI technologies.

The ethical considerations in the US context of generative AI implementation in healthcare involve addressing a range of challenges, including patient privacy, legal responsibility, and fairness. The development of comprehensive regulatory frameworks and guidelines, grounded in ethical principles and tailored to the unique challenges of generative AI in healthcare, is essential for the responsible integration of AI in the US healthcare system.

5. Case studies and examples

5.1. Highlighting specific cases of generative AI implementation

Generative AI has been increasingly implemented in various aspects of healthcare, leading to significant advancements as well as ethical challenges. Vallverdú (2023) provides a comprehensive exploration of the use of Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) in medical diagnosis. A case study featuring "Emily" demonstrates how generative AI can support complex medical diagnoses, highlighting its potential in improving diagnostics, treatment planning, and medical research. However, this case also brings to light ethical challenges such as biases in training data, interpretability of generative AI-generated medical images, and the implications of self-diagnosis influenced by generative AI models.

Musalamadugu and Kannan (2023) discuss the application of generative AI in medical imaging analysis. Their work includes case studies where GANs and VAEs are used to enhance medical imaging, thereby improving disease diagnosis and treatment planning. These case studies reveal the ethical, legal, and regulatory concerns that arise, particularly regarding patient privacy, data protection, and fairness in the use of AI in medical imaging.

Yu, Xu, Hu, and Deng (2023) focus on the integration of generative AI and Large Language Models (LLMs) in healthcare. They present a scoping literature review that includes case studies demonstrating the use of these technologies in enhancing data management, information retrieval, and decision-making processes in healthcare. The review underscores the ethical and legal dimensions of generative AI, emphasizing the need for inclusive, collaborative co-design processes that engage all stakeholders, including clinicians and consumers.

5.1.1. Ethical Challenges of generative AI in healthcare

The case studies presented in these works highlight several ethical challenges faced in the implementation of generative AI in healthcare. Vallverdú (2023) emphasizes the ethical implications of AI-generated medical images, including the potential for anatomical inaccuracies and the phenomenon of "Dr. Google," where patients may rely on generative AI for self-diagnosis. This raises concerns about health literacy and the responsible use of online information.

Musalamadugu and Kannan (2023) address the challenges of ensuring anatomical accuracy and minimizing biases in training data for generative AI models used in medical imaging. They also highlight the importance of interpretability in generative AI-generated results to ensure trustworthiness and fairness.

Yu et al. (2023) discuss the ethical considerations in integrating generative AI and LLMs into healthcare, focusing on the need for transparency, accountability, and adherence to ethical and legal guidelines. They advocate for continued innovation in data acquisition, model fine-tuning, and system implementation, while ensuring the responsible application of these technologies.

5.1.2. Responses and Solutions Adopted

In response to these challenges, the authors propose various solutions. Vallverdú (2023) advocates for interdisciplinary collaborations to establish ethical guidelines and ensure responsible generative AI use in healthcare. This includes promoting health literacy and encouraging collaborative decision-making between patients and healthcare providers.

Musalamadugu and Kannan (2023) recommend the development of technical solutions to minimize risks of bias or error in AI models. They emphasize the need for transparency in generative AI/ML algorithms and the protection of patient well-being, suggesting that developers and healthcare professionals work together to address these ethical challenges.

Yu et al. (2023) propose a comprehensive roadmap for the integration of generative AI and LLMs in healthcare. This roadmap includes the development of ethical principles and guidelines, as well as the implementation of strategies to ensure responsible and ethical generative AI practices. They emphasize the importance of engaging all relevant stakeholders in the development and deployment of generative AI technologies in healthcare.

These case studies illustrate the potential of generative AI in transforming healthcare, while also highlighting the ethical challenges that arise from its implementation. The responses and solutions adopted in these cases provide valuable insights into how the healthcare sector can navigate these challenges, ensuring that the benefits of generative AI are realized in a responsible and ethical manner.

5.2. Responses and Solutions to Ethical Challenges

5.2.1. Addressing Ethical Challenges in Generative AI

The implementation of generative AI in healthcare has raised significant ethical challenges, necessitating the development of comprehensive responses and solutions. Oniani et al. (2023) propose the GREAT PLEA ethical principles, encompassing governance, reliability, equity, accountability, traceability, privacy, lawfulness, empathy, and autonomy, for generative AI in healthcare. These principles are designed to proactively address the ethical dilemmas and challenges posed by the integration of generative AI in healthcare, ensuring responsible and ethical use of this technology.

In their work, Oniani et al. (2023) also discuss the adoption and expansion of ethical principles from the military to healthcare. They highlight the similarities between the challenges faced in military and medical services, particularly in situations requiring quick decision-making under pressure. The proposed ethical framework aims to guide the use of generative AI in healthcare, balancing technical innovation with ethical applications.

Eslamitabar et al. (2024) examine the legal and ethical challenges of generative AI applications in healthcare, emphasizing the need for regulatory frameworks governing generative AI use. They discuss the importance of recognizing and mitigating risks associated with generative AI, including vagueness, complexity, data dependency, and automated behavior. The paper suggests legal solutions for harm resulting from these risks and highlights the pivotal role of generative AI in advancing reliable prediction capabilities in healthcare.

5.2.2. Implementing Ethical Principles and Legal Frameworks

The implementation of ethical principles and legal frameworks is crucial in addressing the challenges posed by generative AI in healthcare. Oniani et al. (2023) advocate for the integration of the GREAT PLEA principles in the development and deployment of generative AI technologies. This approach ensures that ethical considerations are at the forefront of generative AI use in healthcare, promoting transparency, minimizing biases, and protecting patient well-being.

Eslamitabar et al. (2024) emphasize the need for healthcare professionals and institutions to manage the challenges of generative AI use effectively. They advocate for compliance with regulations and the implementation of privacy measures to address the risks associated with generative AI in healthcare. The paper underscores the importance of informed consent and malpractice considerations in the legal framework governing generative AI applications.

5.2.3. Future Directions and Recommendations

The integration of generative AI in healthcare requires ongoing innovation and adaptation of ethical and legal frameworks. Oniani et al. (2023) suggest that future research and development should focus on refining these ethical principles and legal frameworks to keep pace with technological advancements. They recommend interdisciplinary collaborations to establish comprehensive guidelines for responsible generative AI use in healthcare. Eslamitabar et al. (2024) call for continued examination and implementation of regulatory frameworks in the United States and the European Union. They highlight the need for healthcare institutions to stay informed about the evolving legal landscape surrounding generative AI use and to adapt their practices accordingly.

Addressing the ethical challenges of generative AI in healthcare involves the adoption of robust ethical principles and legal frameworks. The implementation of these measures is essential to ensure the responsible and beneficial use of generative AI technologies in healthcare, safeguarding patient rights and promoting equitable healthcare outcomes.

6. Recommendations

6.1. Synthesis of Findings

6.1.1. Common Ethical Themes Across Countries

The review of ethical considerations in implementing generative AI across India, the United Kingdom, and the United States reveals several common themes. Across these countries, there is a shared concern for patient privacy, data security, and the potential for bias in generative AI-generated decisions. Each country emphasizes the need for transparency and accountability in AI systems, particularly in healthcare applications where patient outcomes and resource allocation are directly impacted.

In all three regions, there is a recognition of the potential of generative AI to transform healthcare delivery. However, this is tempered by an understanding of the ethical implications of such technology. Concerns about the interpretability of generative AI decisions, the integrity of data used in generative AI models, and the equitable distribution of AI benefits are prevalent. The importance of adhering to established ethical frameworks and guidelines is a recurring theme, highlighting the need for a proactive approach to the ethical implementation of generative AI technologies.

6.1.2. Unique Challenges and Considerations in Each Country

While there are common ethical themes, each country also presents unique challenges and considerations. In India, the focus is on balancing technological advancements with the socio-cultural context and addressing disparities in healthcare access. The UK's approach is characterized by efforts to adapt existing legal and regulatory frameworks to the rapidly evolving generative AI landscape, particularly in the context of generative AI-enabled medical devices. In the United States, the emphasis is on navigating the balance between innovation and ethical considerations, with a significant focus on the legal implications of generative AI in healthcare.

India's challenges stem from its diverse population and varying levels of healthcare infrastructure, necessitating tailored generative AI solutions that are culturally sensitive and inclusive. The UK faces the task of aligning its regulatory framework with international standards while ensuring that generative AI applications in healthcare are safe, effective, and ethically sound. In the United States, the integration of generative AI in healthcare must address concerns about systematic biases, data protection, and the impact of AI on healthcare relationships and patient rights.

The synthesis of findings from India, the United Kingdom, and the United States reveals a complex landscape of ethical considerations in the implementation of generative AI in healthcare. While there are shared concerns and themes, each country's unique socio-cultural, legal, and regulatory context shapes its approach to addressing these challenges. The need for a balanced, ethical, and contextually appropriate implementation of generative AI technologies in healthcare is a unifying priority across these diverse regions.

6.2. Recommendations for Ethical Implementation

6.2.1. Best Practices for Incorporating Ethical Considerations

The ethical implementation of generative AI in healthcare requires a set of best practices that are universally applicable, yet adaptable to specific regional contexts. These best practices should include:

- **Development of Inclusive Ethical Frameworks:** Ethical frameworks should be developed with input from a diverse range of stakeholders, including healthcare professionals, patients, ethicists, and technologists. These frameworks should address key concerns such as patient privacy, data security, and algorithmic transparency.
- **Regular Ethical Audits and Assessments:** Implementing regular audits and assessments of generative AI systems can ensure ongoing adherence to ethical standards. These audits should evaluate the fairness and accuracy of generative AI algorithms, the security of patient data, and the overall impact of generative AI applications on patient care and healthcare equity.
- **Training and Education:** Healthcare professionals and generative AI developers should receive training on the ethical implications of generative AI in healthcare. This training should cover topics like data privacy, bias in generative AI, and the importance of maintaining human oversight in generative AI-driven decision-making processes.
- **Public Engagement and Transparency:** Engaging the public in discussions about generative AI in healthcare is crucial for building trust. Transparency about how generative AI systems are developed, how data is used, and how decisions are made can help demystify generative AI technologies and address public concerns.
- **Interdisciplinary Collaboration:** Collaboration between technologists, healthcare providers, ethicists, and legal experts is essential to ensure that generative AI systems are not only technologically advanced but also ethically sound and legally compliant.

6.2.2. Future Directions for Research and Policy Development

Looking forward, research and policy development should focus on several key areas:

- 1. Exploring the Impact of generative AI on Healthcare Disparities: Research should investigate how AI might exacerbate or mitigate healthcare disparities. Policies should aim to ensure equitable access to generative AI-driven healthcare innovations.
- 2. Legal and Regulatory Adaptations: As generative AI technologies evolve, legal and regulatory frameworks must be adapted to ensure they remain relevant and effective. This includes international collaboration to establish standards and guidelines for the ethical use of generative AI in healthcare.
- 3. Advancing generative AI Explainability: Continued research into making generative AI systems more interpretable and explainable can enhance trust and reliability in generative AI-driven healthcare decisions.
- 4. Evaluating Long-term Outcomes: Long-term studies are needed to assess the impact of generative AI on healthcare outcomes, patient satisfaction, and healthcare systems. These studies can inform ongoing improvements and policy adjustments.
- 5. Ethical Design and Deployment: Future research should focus on ethical design principles for generative AI in healthcare, ensuring that these systems are designed and deployed with ethical considerations at the forefront.

The ethical implementation of generative AI in healthcare requires a multifaceted approach that encompasses the development of inclusive ethical frameworks, regular audits, education, public engagement, and interdisciplinary collaboration. Future research and policy development should focus on addressing healthcare disparities, adapting legal and regulatory frameworks, enhancing generative AI explainability, evaluating long-term outcomes, and prioritizing ethical design and deployment. These efforts will ensure that generative AI is used responsibly and beneficially in healthcare, aligning with ethical standards and contributing to improved patient care and healthcare systems globally.

7. Conclusion

7.1. Recapitulation of Key Findings

This review has systematically explored the ethical considerations in implementing generative AI across India, the United Kingdom, and the United States, focusing on healthcare supply chain optimization. Key findings include the identification of common ethical themes such as the need for data privacy, algorithmic transparency, and equitable access to generative AI-driven healthcare solutions. Each country presents unique challenges shaped by its socio-cultural, legal, and regulatory contexts, necessitating tailored approaches to ethical AI implementation.

The review highlights the critical role of interdisciplinary collaboration, inclusive ethical frameworks, and public engagement in addressing these challenges. Regular ethical audits, education for healthcare professionals and generative AI developers, and transparent communication are essential for maintaining trust and ensuring responsible generative AI use.

7.2. Final Thoughts on the Ethical Landscape

The ethical landscape of implementing generative AI in healthcare is complex and evolving. As generative AI technologies continue to advance, they offer significant opportunities to enhance healthcare delivery and outcomes. However, this potential must be balanced with a vigilant approach to ethical considerations, ensuring that generative AI benefits are realized without compromising ethical standards or exacerbating healthcare disparities.

Future directions for research and policy development should focus on exploring the impact of generative AI on healthcare disparities, adapting legal and regulatory frameworks, advancing AI explainability, and evaluating long-term outcomes. Ethical design and deployment of generative AI systems should be a priority, with a focus on creating generative AI solutions that are not only technologically advanced but also ethically sound and culturally sensitive.

The ethical implementation of generative AI in healthcare requires a collaborative, multidisciplinary effort. By adhering to robust ethical principles and continuously adapting to emerging challenges, the healthcare sector can harness the full potential of generative AI technologies to improve patient care and healthcare systems worldwide.

7.3. Recapitulation of Key Findings

This review has systematically explored the ethical considerations in implementing generative AI across India, the United Kingdom, and the United States, focusing on healthcare supply chain optimization. Key findings include the identification of common ethical themes such as the need for data privacy, algorithmic transparency, and equitable access to generative AI-driven healthcare solutions. Each country presents unique challenges shaped by its socio-cultural, legal, and regulatory contexts, necessitating tailored approaches to ethical generative AI implementation.

The review highlights the critical role of interdisciplinary collaboration, inclusive ethical frameworks, and public engagement in addressing these challenges. Regular ethical audits, education for healthcare professionals and generative AI developers, and transparent communication are essential for maintaining trust and ensuring responsible generative AI use.

7.4. Final Thoughts on the Ethical Landscape

The ethical landscape of implementing generative AI in healthcare is complex and evolving. As generative AI technologies continue to advance, they offer significant opportunities to enhance healthcare delivery and outcomes. However, this potential must be balanced with a vigilant approach to ethical considerations, ensuring that generative AI benefits are realized without compromising ethical standards or exacerbating healthcare disparities.

Future directions for research and policy development should focus on exploring the impact of generative AI on healthcare disparities, adapting legal and regulatory frameworks, advancing generative AI explainability, and evaluating long-term outcomes. Ethical design and deployment of generative AI systems should be a priority, with a focus on creating generative AI solutions that are not only technologically advanced but also ethically sound and culturally sensitive.

In conclusion, the ethical implementation of generative AI in healthcare requires a collaborative, multidisciplinary effort. By adhering to robust ethical principles and continuously adapting to emerging challenges, the healthcare sector can harness the full potential of generative AI technologies to improve patient care and healthcare systems worldwide.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Amugongo, L. M., Kriebitz, A., Boch, A., & Lütge, C. (2023). Operationalising AI ethics through the agile software development lifecycle: a case study of AI-enabled mobile health applications. *AI and Ethics*. [DOI: 10.1007/s43681-023-00331-3](https://dx.doi.org/10.1007/s43681-023-00331-3)

[2] Baric-Parker, J., & Anderson, E. (2020). Patient Data-Sharing for AI: Ethical Challenges, Catholic Solutions. [DOI: 10.1177/0024363920922690](https://dx.doi.org/10.1177/0024363920922690)

[3] Busch, F., Adams, L. C., & Bressem, K. (2023). Biomedical Ethical Aspects Towards the Implementation of Artificial Intelligence in Medical Education. *Medical Science Educator*. [DOI: 10.1007/s40670-023-01815-x](https://dx.doi.org/10.1007/s40670-023-01815-x)

[4] Dijmărescu, E. (2023). AI Trends: Salient Aspects for the Manufacturing Sector and Its Global Supply Chain. *BASIQ*. [DOI: 10.24818/basiq/2023/09/053](https://dx.doi.org/10.24818/basiq/2023/09/053)

[5] Drabiak, K., Kyzer, S., Nemov, V., & El Naqa, I. (2023). AI and ML ethics, Law, Diversity, and Global Impact. *British Journal of Radiology*. [DOI: 10.1259/bjr.20220934](https://dx.doi.org/10.1259/bjr.20220934)

[6] Guo, W. (2023). Exploring the Value of AI Technology in Optimizing and Implementing Supply Chain Data for Pharmaceutical Companies. *IST*. [DOI: 10.56397/ist.2023.05.01](https://dx.doi.org/10.56397/ist.2023.05.01)

[7] Hao, X., & Demir, E. (2023). Artificial intelligence in supply chain decision-making: an environmental, social, and governance triggering and technological inhibiting protocol. *Journal of Management Development*. [DOI: 10.1108/jm2-01-2023-0009](https://dx.doi.org/10.1108/jm2-01-2023-0009)

[8] Jain, Y., & Chowdhury, S. A. (2019). Indian healthcare through the global health ethics lens: despite some gains, have we truly progressed? *Global Public Health*. [DOI: 10.1080/17449626.2019.1582556](https://dx.doi.org/10.1080/17449626.2019.1582556)

[9] Kalyanakrishnan, S., Panicker, R., Natarajan, S., & Rao, S. (2018). Opportunities and Challenges for Artificial Intelligence in India. *ACM Computing Surveys*. [DOI: 10.1145/3278721.3278738](https://dx.doi.org/10.1145/3278721.3278738)

[10] Li, P., Williams, R., Gilbert, S., & Anderson, S. (2023). Regulating Artificial Intelligence and Machine Learning-Enabled Medical Devices in Europe and the United Kingdom. *Law, Technology and Humans*. [DOI: 10.5204/lthj.3073](https://dx.doi.org/10.5204/lthj.3073)

[11] MohammadAmini, M., Jesus, M., Sheikholeslami, D. F., Alves, P., Hassanzadeh Benam, A., & Hariri, F. (2023). Artificial Intelligence Ethics and Challenges in Healthcare Applications: A Comprehensive Review in the Context of the European GDPR Mandate. *Machines*. [DOI: 10.3390/make5030053](https://dx.doi.org/10.3390/make5030053)

[12] Moon, G., Yang, J. H., Son, Y.-N., Choi, E. K., & Lee, I. (2023). Ethical Principles and Considerations concerning the Use of Artificial Intelligence in Healthcare. *Korean Society of Medical Ethics*. [DOI: 10.35301/ksme.2023.26.2.103](https://dx.doi.org/10.35301/ksme.2023.26.2.103)

[13] Musalamadugu, T. S., & Kannan, H. (2023). Generative AI for medical imaging analysis and applications. Future Medicine. [DOI: 10.2217/fmai-2023-0004](https://dx.doi.org/10.2217/fmai-2023-0004)

[14] Ning, Y., Teixayavong, S., Shang, Y., Savulescu, J., Nagaraj, V., Miao, D., Mertens, M., Ting, D., Ong, J., Liu, M., Cao, J., Dunn, M., Vaughan, R., Ong, M., Sung, J. J.-Y., Topol, E. J., & Liu, N. (2023). Generative Artificial Intelligence in Healthcare: Ethical Considerations and Assessment Checklist. *arXiv*. [DOI: 10.48550/arXiv.2311.02107](https://dx.doi.org/10.48550/arXiv.2311.02107)

[15] Oniani, D., Hilsman, J., Peng, Y., Poropatich, R. K., Pamplin, J. C., Legault, G. L., & Wang, Y. (2023). Adopting and expanding ethical principles for generative artificial intelligence from military to healthcare. *Nature Digital Medicine*. [DOI: 10.1038/s41746-023-00965-x](https://dx.doi.org/10.1038/s41746-023-00965-x)

[16] Oniani, D., Hilsman, J., Peng, Y., Poropatich, C. R. K., Pamplin, C. J. C., Legault, L. G. L., & Wang, Y. (2023). From Military to Healthcare: Adopting and Expanding Ethical Principles for Generative Artificial Intelligence. *arXiv*. [DOI: 10.48550/arXiv.2308.02448](https://dx.doi.org/10.48550/arXiv.2308.02448)

[17] Painuly, S., Sharma, S., & Matta, P. (2023). Artificial Intelligence in e-Healthcare Supply Chain Management System: Challenges and Future Trends. In *2023 International

[18]   Conference   on   Smart   Computing   and   Data   Science   (ICSCDS)*.   [DOI: 10.1109/ICSCDS56580.2023.10104746](https://dx.doi.org/10.1109/ICSCDS56580.2023.10104746)

[19]   Peters, D., Vold, K., Robinson, D., & Calvo, R. (2020). Responsible AI—Two Frameworks for Ethical Design Practice.   *IEEE   Transactions   on   Technology   and   Society*.   [DOI: 10.1109/TTS.2020.2974991](https://dx.doi.org/10.1109/TTS.2020.2974991)

[20]   Sethi, A., Tangri, T., Puri, D., Singh, A., & Agrawal, K. (2022). Knowledge management and ethical vulnerability in AI. *AI and Ethics*. [DOI: 10.1007/s43681-022-00164-6](https://dx.doi.org/10.1007/s43681-022-00164-6)

[21]   Shokrollahi, Y., Yarmohammadtoosky, S., Nikahd, M. M., Dong, P., Li, X., & Gu, L. (2023). A Comprehensive Review of   Generative   AI   in   Healthcare.   *arXiv*.   [DOI: 10.48550/arXiv.2310.00795](https://dx.doi.org/10.48550/arXiv.2310.00795)

[22]   Solanki, P., Grundy, J., & Hussain, W. (2022). Operationalising ethics in artificial intelligence for healthcare: a framework   for   AI   developers.   *AI   and   Ethics*.   [DOI: 10.1007/s43681-022-00195-z](https://dx.doi.org/10.1007/s43681-022-00195-z)

[23]   Taiwo, E., Akinsola, A., Tella, E., Makinde, K., & Akinwande, M. (2023). A Review of the Ethics of Artificial Intelligence and its Applications in the United States. *International Journal of Computer and Information Technology*. [DOI: 10.5121/ijci.2023.1206010](https://dx.doi.org/10.5121/ijci.2023.1206010)

[24]   Vallverdú, J. (2023). Challenges and Controversies of Generative AI in Medical Diagnosis. *Euphyia*. [DOI: 10.33064/32euph4957](https://dx.doi.org/10.33064/32euph4957)

[25]   Yu, P., Xu, H., Hu, X., & Deng, C. (2023). Leveraging Generative AI and Large Language Models: A Comprehensive Roadmap   for   Healthcare   Integration.   *Healthcare*.   [DOI: 10.3390/healthcare11202776](https://dx.doi.org/10.3390/healthcare11202776)

[26]   Zhang, P., & Boulos, M. (2023). Generative AI in Medicine and Healthcare: Promises, Opportunities and Challenges. *Future Internet*, 15(9), 286. [DOI: 10.3390/fi15090286](https://dx.doi.org/10.3390/fi15090286)

[27]   Baric-Parker, J., & Anderson, E. (2020). Patient Data-Sharing for AI: Ethical Challenges, Catholic Solutions. [DOI: 10.1177/0024363920922690](https://dx.doi.org/10.1177/0024363920922690)

[28]   Drabiak, K., Kyzer, S., Nemov, V., & El Naqa, I. (2023). AI and ML ethics, Law, Diversity, and Global Impact. *British Journal of Radiology*. [DOI: 10.1259/bjr.20220934](https://dx.doi.org/10.1259/bjr.20220934)

[29]   Li, P., Williams, R., Gilbert, S., & Anderson, S. (2023). Regulating Artificial Intelligence and Machine Learning-Enabled Medical Devices in Europe and the United Kingdom. *Law, Technology and Humans*. [DOI: 10.5204/lthj.3073](https://dx.doi.org/10.5204/lthj.3073)

[30]   Mclean, S. (Date not available). Ethics and healthcare: a view from the United Kingdom. [No DOI available]

[31]   Oniani, D., Hilsman, J., Peng, Y., Poropatich, R. K., Pamplin, J. C., Legault, G. L., & Wang, Y. (2023). Adopting and expanding ethical principles for generative artificial intelligence from military to healthcare. *Nature Digital Medicine*. [DOI: 10.1038/s41746-023-00965-x](https://dx.doi.org/10.1038/s41746-023-00965-x)

[32]   Oniani, D., Hilsman, J., Peng, Y., Poropatich, C. R. K., Pamplin, C. J. C., Legault, L. G. L., & Wang, Y. (2023). From Military to Healthcare: Adopting and Expanding Ethical Principles for Generative Artificial Intelligence. *arXiv*. [DOI: 10.48550/arXiv.2308.02448](https://dx.doi.org/10.48550/arXiv.2308.02448)

[33]   Eslamitabar, S., Lame, E., Rouzbahani, A., & Roozbahani, Z. (2024). Legal and Ethical Challenges of Artificial Intelligence   Applications   in   Healthcare.   [DOI: 10.18502/htaa.v7i4.14653](https://dx.doi.org/10.18502/htaa.v7i4.14653)