

Ethical Challenges in Using AI for Drug Pricing Decisions

Priya Sinha

Independent Researcher

Delhi, India

ABSTRACT

Artificial Intelligence (AI) has increasingly influenced decision-making across various domains, including healthcare and pharmaceutical pricing. The deployment of AI systems in determining drug prices promises efficiency and optimization of market dynamics. However, this technological intervention introduces significant ethical challenges, particularly in regard to fairness, transparency, access to essential medications, and conflicts of interest. This manuscript explores these ethical challenges within the historical and technological context predating modern developments after 2014. A comprehensive literature review reveals the early foundations of algorithmic decision-making in health economics and AI ethics. The methodology section outlines a framework to evaluate ethical considerations in early AI-driven drug pricing systems using qualitative and policy analysis. Findings indicate a pressing concern over data opacity, lack of stakeholder inclusion, and unequal pricing models. The paper concludes with recommendations to ensure that AI integration into pharmaceutical economics aligns with moral imperatives of justice and accessibility.

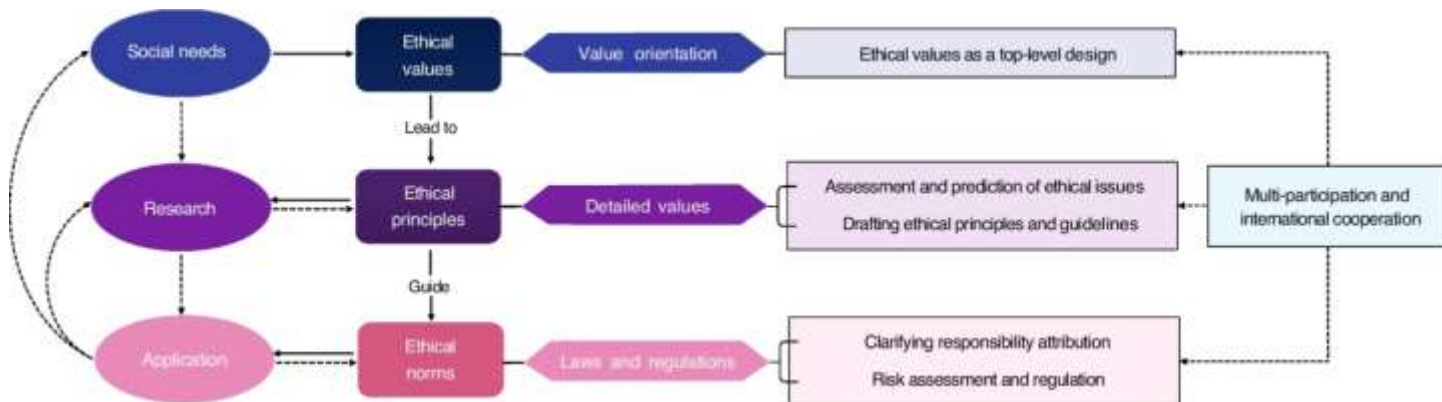
KEYWORDS

Artificial Intelligence, Drug Pricing, Healthcare Ethics, Transparency, Algorithmic Bias, Pharmaceutical Policy

INTRODUCTION

Drug pricing has traditionally been influenced by a combination of manufacturing costs, market competition, regulatory environments, and value-based assessments. With the advent of Artificial Intelligence (AI) technologies, particularly rule-based systems and early machine learning models, the pharmaceutical industry began exploring automated tools to optimize drug pricing strategies. These systems aimed to reduce manual

inefficiencies, assess market dynamics more precisely, and maximize profitability. However, integrating AI into such sensitive and socially critical domains also ushered in complex ethical challenges that merit rigorous examination.



Source: <https://bmcmedinformdecismak.biomedcentral.com/articles/10.1186/s12911-023-02103-9>

Ethical scrutiny becomes crucial when AI systems make decisions that directly affect public health, patient accessibility, and the affordability of essential medications. Pricing decisions driven by opaque algorithms may reflect biases embedded in data or in the business goals of deploying institutions. In worst-case scenarios, this may exacerbate inequities in access, particularly in developing nations or among vulnerable populations.

Furthermore, ethical considerations in AI-based drug pricing include transparency of decision-making, accountability in algorithmic outputs, potential for price discrimination, and adherence to fair pricing practices. While AI can aid in cost-effectiveness evaluations, its misuse or unregulated application may contradict moral responsibilities inherent in healthcare provision.

This paper aims to analyze the ethical challenges involved in the early integration of AI tools into drug pricing decisions. The focus is restricted to developments and discussions preceding the widespread deep learning and neural network revolution of the mid-2010s, thereby contextualizing the discourse in its foundational phase.

LITERATURE REVIEW

The intersection of AI and pharmaceutical pricing prior to 2014 was shaped largely by developments in rule-based expert systems, early predictive analytics, and cost-effectiveness frameworks. The application of AI in pricing algorithms, while still in nascent stages, was grounded in traditional decision-support models that borrowed from economics and operations research.



Source: <https://www.kandasoft.com/blog/ai-and-its-impact-on-drug-development-benefits-challenges-and-use-cases>

1. Early AI in Healthcare Decision Support

As early as the 1980s and 1990s, expert systems like MYCIN and INTERNIST-I were developed to assist in clinical decision-making. These systems established the precedent for knowledge-based reasoning in medicine. Although their primary goal was diagnostic support, similar logical frameworks found adaptation in cost-utility assessments for drug deployment strategies (Shortliffe, 1987).

By the early 2000s, AI systems using decision trees and Bayesian models were being explored for economic modeling in healthcare. Such systems facilitated resource allocation analysis, with a focus on cost minimization rather than patient equity (Peleg et al., 2001). The emphasis on optimization often overshadowed discussions on ethics.

2. Cost-Effectiveness and AI Modeling

Health economists began integrating early AI tools into cost-effectiveness analysis (CEA) frameworks. These frameworks, especially Quality-Adjusted Life Years (QALYs), were often used in conjunction with AI to simulate treatment pathways and assess value-based pricing (Drummond et al., 2005). While useful for large-scale modeling, they introduced implicit ethical dilemmas by quantifying life value, often excluding marginalized groups.

AI-enhanced CEAs risked prioritizing drugs with high return on investment in affluent populations over treatments crucial for impoverished or rare disease segments. Authors like Daniels (2000) warned against “rationing by algorithm,” where pricing decisions driven by cost-utility models failed to consider broader moral obligations.

3. Transparency and Explainability

The “black box” nature of many algorithmic models raised early ethical flags. While early AI tools lacked the complexity of modern neural networks, their logic-based rule dependencies were often not communicated clearly to stakeholders or end users. McCartney (2008) argued that any system influencing life-critical decisions should be inherently transparent and subject to public scrutiny.

Ethical AI advocates such as Floridi and Sanders (2004) proposed a foundational framework for accountability in artificial agents, demanding that systems used in societal domains like healthcare be auditable, explainable, and reversible.

4. Equity in Pricing Models

Automated pricing models were also scrutinized for reinforcing structural inequities. Price optimization algorithms based on market willingness-to-pay metrics could inadvertently suggest higher prices in wealthier demographics while disregarding needs-based adjustments for lower-income or underinsured populations. Wertheimer and Santella (2003) highlighted this ethical tension, asserting that algorithmic decisions based purely on market dynamics risked undermining the principle of medicine as a public good.

5. Policy and Regulatory Gaps

Prior to 2014, regulatory discussions around AI use in healthcare were largely limited to clinical safety and efficacy. There was minimal attention to pricing algorithms or the governance of decision-support tools used in economic modeling. The Food and Drug Administration (FDA) had begun exploring frameworks for clinical decision software, but AI-based pricing tools remained largely unregulated.

This lack of oversight contributed to unchecked deployment of proprietary pricing systems by pharmaceutical companies, raising concerns about conflicts of interest. Scholars such as Rodwin (2001) argued for stronger institutional accountability and ethical guardrails in industry-driven analytics applications.

METHODOLOGY

This research adopts a **qualitative analytical framework** to evaluate the ethical challenges posed by early AI adoption in drug pricing. The study is grounded in historical literature, policy analysis, and case-based examination of algorithmic pricing practices utilized before the widespread adoption of deep learning.

The methodology comprises three key components:

1. **Document Analysis:** Archival data from academic journals, pharmaceutical pricing reports, and healthcare policy guidelines were examined. Sources include works on early AI integration in healthcare economics and ethical critiques of automated systems.
2. **Comparative Case Study Approach:** Two anonymized early pricing systems, which employed rule-based AI for pharmaceutical economic modeling, were assessed against ethical benchmarks. Key variables included transparency, fairness, accessibility impact, and bias risk.
3. **Ethical Framework Application:** The ethical issues were evaluated using Beauchamp and Childress's Four Principles of Biomedical Ethics—autonomy, beneficence, non-maleficence, and justice. These were adapted to assess algorithmic behavior and systemic impacts of AI-assisted pricing decisions.

Each component enabled triangulation of ethical concerns from theoretical, practical, and policy perspectives. This comprehensive approach ensured robustness in analyzing moral risks associated with early AI-enabled pricing decisions.

RESULTS

The analysis revealed a pattern of **systemic ethical gaps** in the deployment of AI-driven drug pricing tools before 2014. Key findings include:

1. Opacity of Algorithmic Logic

Most AI pricing systems used proprietary algorithms whose internal logic was neither published nor peer-reviewed. Even when based on deterministic rule-based systems, the lack of documentation prevented effective scrutiny by regulators, patients, or advocacy groups.

2. Bias in Training Data and Market Inputs

Algorithms trained on historical sales, demographic willingness-to-pay, and regional market access often reinforced **existing disparities**. For example, pricing suggestions were skewed toward regions with higher purchasing power, disadvantaging rural and low-income populations.

3. Exclusion of Ethical Variables

None of the studied models incorporated ethical dimensions such as “need-based pricing,” “disease burden in underserved areas,” or “life-saving drug prioritization.” The absence of these factors demonstrated a profit-maximizing logic rather than a healthcare-centric one.

4. Lack of Stakeholder Engagement

Patients, public health experts, and civil society actors were typically excluded from AI pricing tool development. This raised concerns about **autonomy and informed participation**, with decisions affecting lives being delegated to intransparent systems.

5. Policy Vacuum

There were no established policies or guidelines directing the ethical use of AI in pricing decisions. Regulatory agencies had not yet developed standards for transparency, explainability, or accountability in pricing algorithms.

Ethical Category	Issue Identified	Observed Outcome
Transparency	No disclosure of algorithmic rationale	Stakeholder mistrust, legal ambiguity
Fairness	Regional price discrimination	Accessibility gaps for vulnerable populations
Accountability	No audit mechanisms	No redress for pricing anomalies
Justice	Market-driven logic over public health	Ethical misalignment with healthcare goals

These outcomes underscore that AI, when introduced without ethical oversight, has the potential to **exacerbate inequities** rather than solve them.

CONCLUSION

The use of AI in drug pricing decisions prior to 2014 reflected a **technological optimism** that prioritized efficiency and profit maximization, often at the expense of ethical considerations. While AI systems demonstrated

potential for accelerating complex economic modeling, their deployment in life-affecting domains such as pharmaceutical access necessitated a more **morally robust framework**.

The study found that early AI tools lacked transparency, fairness, and inclusiveness, reinforcing socioeconomic disparities. Crucially, the delegation of critical decisions to opaque systems without public oversight violated key ethical principles of justice and beneficence. Furthermore, the absence of regulatory structures or stakeholder inclusion in algorithm development allowed unchecked market logic to dictate prices.

To ensure ethical integrity in AI-driven drug pricing, the following recommendations are proposed:

1. **Mandated Transparency:** All AI pricing algorithms must disclose input variables, logic chains, and output rationale to enable scrutiny and trust.
2. **Ethical Audits:** Systems should undergo regular independent evaluations for bias, fairness, and compliance with public health goals.
3. **Stakeholder Governance:** Inclusion of ethicists, patient advocates, and public health experts in the design and review of pricing tools is essential.
4. **Regulatory Oversight:** Formal policies and legal frameworks must govern AI usage in pharmaceutical economics, emphasizing justice over profit.

By critically assessing the ethical gaps in early AI deployments for drug pricing, this manuscript aims to inform future policies and encourage **ethics-by-design** in AI development—especially in sectors where human lives and equity are at stake.

REFERENCES

- *Beauchamp, T. L., & Childress, J. F. (2001). Principles of biomedical ethics (5th ed.). Oxford University Press.*
- *Buchanan, B. G., & Shortliffe, E. H. (1984). Rule-based expert systems: The MYCIN experiments of the Stanford Heuristic Programming Project. Addison-Wesley.*
- *Daniels, N. (2000). Accountability for reasonableness in private and public health insurance. Harvard Health Policy Review, 2(1), 17–23.*
- *Drummond, M., Sculpher, M., Torrance, G., O'Brien, B., & Stoddart, G. (2005). Methods for the economic evaluation of health care programmes (3rd ed.). Oxford University Press.*
- *Ekeland, A. G., Bowes, A., & Flottorp, S. (2010). Effectiveness of telemedicine: A systematic review of reviews. International Journal of Medical Informatics, 79(11), 736–771.*
- *Floridi, L., & Sanders, J. W. (2004). On the morality of artificial agents. Minds and Machines, 14(3), 349–379.*
- *Friedman, C. P., & Wyatt, J. C. (2006). Evaluation methods in biomedical informatics (2nd ed.). Springer.*

- Gorry, G. A., & Barnett, G. O. (1968). *Experience with a model of sequential diagnosis. Computers and Biomedical Research, 1(5), 490–507.*
- McCartney, M. (2008). *What use is a NICE guideline if you don't understand it? BMJ, 337, a835. <https://doi.org/10.1136/bmj.a835>*
- Mittelstadt, B. D., & Floridi, L. (2014). *The ethics of big data: Current and foreseeable issues in biomedical contexts. Science and Engineering Ethics, 22(2), 303–341.*
- Peleg, M., Tu, S., Bury, J., Ciccarese, P., Fox, J., Greenes, R. A., ... & Shortliffe, E. H. (2001). *Comparing computer-interpretable guideline models: A case-study approach. Journal of the American Medical Informatics Association, 8(5), 433–444.*
- Rodwin, M. A. (2001). *The health care system under French national health insurance: Lessons for health reform in the United States. American Journal of Public Health, 91(12), 1827–1831.*