Scoping Review: Legal and Ethical Principles of Artificial Intelligence in Public Health

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Abstract. The growing accessibility of large health datasets and AI's ability to analyze them offers significant potential to transform public health and epidemiology. AI-driven interventions in preventive, diagnostic, and therapeutic healthcare are becoming more prevalent, but they raise ethical concerns, particularly regarding patient safety and privacy. This study presents a thorough analysis of ethical and legal principles found in the literature on AI applications in public health. A comprehensive search yielded 22 publications for review, revealing ethical principles such as equity, bias, privacy, security, safety, transparency, confidentiality, accountability, social justice, and autonomy. Additionally, five key ethical challenges were identified. The study emphasizes the importance of addressing these ethical and legal concerns and encourages further research to establish comprehensive guidelines for responsible AI implementation in public health.

Keywords. Ethical, Legal, Artificial Intelligence, Equity, Public Health.

1. Introduction

AI has the potential to significantly transform healthcare and society [1]. Despite the absence of a universally accepted definition [2], AI involves reasoning, learning, adaptation, sensory comprehension, and interaction [3]. The early 2000s witnessed renewed attention to AI due to increased computer power, data capacity, and theoretical advancements [4]. AI has started to penetrate healthcare and public health fields, with experts suggesting that AI-based medical devices and algorithms will play a major role in preventive, diagnostic, and therapeutic interventions [5,6]. However, the impact of AI on public health has received less attention [5]. Public health aims to protect and promote the health of the entire population, with planning and evaluation being two new activities [7,8]. Achieving optimal health outcomes involves developing interventions targeting preventable causes of ill health [9]. Accurately evaluating disease burden or risk factors in the population is crucial for success, with systematic evaluation and synthesis of available data being the most common foundation for evidence-informed decision making in public health [10]. Emerging AI technologies can process and interpret a wide range of structured and unstructured data [2], potentially transforming public health and

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epidemiology by providing insights into disease determinants at both population and individual levels and speeding up public health surveillance and policy shaping [6]. Public health practitioners and researchers have already started utilizing AI in tasks such as outbreak scanning, suicide prediction using electronic health records, and risk factor detection [5]. Despite growing optimism about AI's potential to improve public health, few AI systems have been adopted in public health institutions [11]. Concerns about the impact of AI on privacy, interpretability, and bias need to be addressed for accelerated adoption of AI in public health [12]. AI technologies can transform healthcare settings and interactions, but concerns about their unique attributes and potential dangers have been raised [13]. As technological progress continues rapidly, the need for regulatory measures has become urgent. However, there is a lack of comprehensive review on the ethical and legal concepts related to AI in the public health domain [13]. This scoping review aims to address the gaps, strengths, and limitations of previous literature, providing a holistic perspective on the ethical and legal challenges associated with the use of AI in public health, and addressing common ethical and legal principles in the included studies.

2. Methods

A scoping review following PRISMA-ScR guidelines [14] evaluated legal and ethical principles related to AI in public health from January 2015 to February 28th, 2022. The review utilized databases such as Medline (PubMed), Scopus, JSTOR, IEEE Xplore, and Google Scholar, limited to the first ten pages sorted by relevance. Backward and forward reference list checking identified supplementary studies. The search strategy encompassed three key elements: population, intervention, and outcomes. Search terms targeted literature on public health and AI, focusing on ethical and legal aspects. Appendix A[2] contains detailed search strings for each database. The review aimed to examine legal and ethical principles, excluding AI applications in medical and clinical fields. Inclusion criteria covered peer-reviewed publications, reports, conference proceedings, theses, and dissertations, while excluding conference abstracts, reviews, and proposals. No restrictions were applied to study settings, population age and gender, study design, reported outcomes, or publication country. Appendix B[2] outlines inclusion and exclusion criteria. A two-stage process screened and extracted data. Four independent reviewers initially screened titles and abstracts using Rayyan [15], removing duplicates based on inclusion criteria. Full texts of potential articles were assessed for eligibility, with additional reviewers resolving uncertainties. The study selection process flow chart is in Appendix C[2]. Data extraction employed a pre-designed Excel sheet, including information such as author names, publication date, study setting, study type, study aim, ethical principles, legal issues, and reported findings. Appendix D[2] summarizes the included studies. Disagreements were resolved through additional reviewer participation. Narrative synthesis methods analyzed the extracted data, categorizing literature based on common ethical and legal themes in the studies.

3. Results

We identified 1123 articles from five databases, and after screening for eligibility, included 22 articles in our review. Appendixes E[2] and F[2] provide overviews of study

characteristics and key ethical and legal themes in AI use for public and community health. These themes include equity, bias, privacy, security, safety, transparency, confidentiality, accountability, social justice, and autonomy. Privacy and security were the most addressed (n=5), followed by health equity (n=5), avoiding bias (n=4), confidentiality (n=3), transparency/autonomy (n=3), safety (n=2), and accountability (n=2). Social justice was least addressed (n=1). Five papers emphasized health equity, discussing the unequal distribution of health outcomes and the importance of prioritizing equality and fairness in AI design and use. Access to digital health technologies varies, leading to disparities; fair treatment policies and practices are needed for underserved populations. Two articles on accountability highlighted its significance in AI-based technology design and implementation. An accountability framework was suggested to ensure that AI system decisions are reviewed and deemed suitable for public use. Four papers addressed bias, stressing the need to reduce biases during product development and consider data diversity. Five papers focused on privacy and security, emphasizing patient data protection, addressing public privacy concerns, and establishing clear confidentiality standards. Three articles discussed confidentiality in AI technology, highlighting the need for robust standards in collaboration with the public health sector. Education is crucial for safe and appropriate AI technology use in healthcare, as it helps users interact with AI systems properly, reducing errors and costs. Transparency, a key challenge in AI use for public health, is vital for better governance. However, it is often lacking, making it difficult to assign accountability and understand decision-making processes. One paper addressed justice, considering local and global contexts and emphasizing fair financial profit allocation among stakeholders for equitable access to digital health technologies and social justice promotion. Two studies discussed autonomy, emphasizing informed consent and transparency in AI algorithm use to ensure patients' autonomy. Ethical challenges in AI use for public health include conflicting economic and sustainable development goals, weak democratic systems, potential citizen experience and power structure repercussions, and contextual factors leading to non-universal healthcare standards (Appendix G[2]).

4. Discussion

This review examines ethical and legal principles related to AI in healthcare, emphasizing themes such as equity, bias, privacy, security, transparency, autonomy, and accountability. Fair distribution of AI technology benefits and burdens among diverse socio-demographic groups is essential. Privacy concerns emerge from wearable fitness devices and geographical health analysis, with techniques like Synthetic Data Generation addressing these issues. An accountability framework is crucial for designing, developing, and deploying AI-based medical technology, addressing challenges and ensuring transparent decision-making. AI designers, developers, and policymakers can use these insights to align products with ethical standards, create frameworks, and avoid unintended consequences. The implementation of ethical and legal principles in AI healthcare depends on rationale, potential benefits, and the impact on population health and patient experience. Addressing legal and ethical challenges is vital for ensuring equal healthcare access. Comprehensive and specific national guidelines are necessary to advance AI in public health while adhering to ethical and legal principles.[2]

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[2] https://doi.org/10.5281/zenodo.7850818

5. Conclusion

In conclusion, AI technology holds immense potential for enhancing community health outcomes in public health. Nevertheless, addressing the associated legal and ethical challenges is vital for responsible and ethical AI deployment. This scoping review highlights key themes, such as safety, equity, transparency, accountability, privacy, security, and bias, that warrant consideration in AI implementation. Further research is required to understand these ethical principles and their implications across healthcare domains. Stakeholders must prioritize ethical and legal alignment in AI model development to promote improved population health outcomes. Ultimately, AI usage in public health should be guided by human rights principles to ensure the benefit of all.

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