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A COMPREHENSIVE SCOPING ANALYSIS OF THE AVAILABLE DATA AND PROSPECTS FOR AI IN PUBLIC HEALTH

Community Medicine

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ABSTRACT

Health systems' methods for predicting, diagnosing, and managing medical disorders are being completely transformed by the application of artificial intelligence (AI) in public health. Current research on the use of AI in community-based primary healthcare (CBPHC) and broader public health interventions is compiled in this systematic scoping review. The paper highlights the substantial potential of expert systems, machine learning (ML), and natural language processing (NLP) in enhancing clinical decision-making, disease surveillance, and behavioral modification techniques [2][3].Despite promising results, issues like algorithmic bias, data opacity, infrastructural constraints, and weak regulatory supervision remain [5]. AI needs to be inclusively created, responsibly managed, and regularly reviewed to be ethically and sustainably integrated into public health [7].

KEYWORDS

Explainable AI, Algorithmic Bias, Health Equity, Community-Based Healthcare, Public Health, Machine Learning, Natural Language Processing, Artificial Intelligence

INTRODUCTION

In public health, AI tools like machine learning, NLP, and expert systems are increasingly used for policymaking, personalized care, and predictive analytics [3][4]. While high-income countries use AI for risk assessment and real-time epidemic monitoring, low- and middle-income countries (LMICs) face adoption barriers due to poor data quality, limited digital infrastructure, and lack of AI training for healthcare workers [2][4].

Goals – The objectives of this review are:

1. To map the current applications of AI in community-based primary healthcare (CBPHC)
2. To evaluate the effects of AI on health outcomes, system readiness, and health equity
3. To identify implementation challenges
4. To propose ethical and practical strategies for integrating AI into public health systems

METHODOLOGY-The review follows the PRISMA-ScR guidelines [1]. A systematic search was conducted (up to December 2023) across seven databases—PubMed, MEDLINE, EMBASE, Web of Science, IEEE Xplore, ScienceDirect, and CINAHL—using terms such as "artificial intelligence," "machine learning," "CBPHC," "surveillance," and "health equity" [2].

Inclusion Criteria – Studies were included if they:

- Involved AI application or evaluation in public or community health
- Were peer-reviewed and published in English
- Provided empirical and scalable insights

Exclusion Criteria – Studies were excluded if they:

- Were theoretical without real-world application
- Did not directly address AI in public health
- Focused solely on inpatient settings
- Were not peer-reviewed

AI in Public Health Based on Communities

Summary of the Included Research

From over 16,000 initial studies, 90 were selected. Most were pilot-level implementations, showing that AI in CBPHC is still in early development stages [2].

AI Tool Types in Use

- 45% used machine learning (e.g., neural networks, decision trees) [3]
- 27% applied natural language processing to analyze unstructured text
- 19% employed expert systems for rule-based decision-making

Illustrations of Uses in Public Health

- Outbreak prediction via digital behavior patterns [6]
- Remote triage and diagnosis using AI tools
- Risk prediction in chronic disease management
- Mental and behavioral health support, such as smoking cessation tools [3]

System and Health Impact

Health Results

AI tools demonstrated high predictive accuracy and effective early warnings. However, generalizability to various populations and settings remains limited [3].

System and Provider Acceptance

Providers reported improved diagnostic accuracy and efficiency. However, challenges included complex setup and skepticism regarding AI-generated results [4].

Ethical, Social, and Implementation Barriers

Equity and Prejudice

AI models often show bias due to over-reliance on data from urban and digitally advanced populations. Rural and underserved communities are underrepresented, limiting model accuracy [5].

Confidence and Clarity

Many AI systems function as "black boxes," offering little insight into their reasoning. Explainable AI (XAI) is being developed to improve transparency and trust [6].

Ethical and Regulatory Obstacles

There is a lack of universal standards for evaluating AI in public health. Privacy regulations vary, and many countries lack independent regulatory bodies [7].

Gaps in Digital Literacy and Infrastructure

Particularly in LMICs, poor digital infrastructure, fragmented health data systems, and limited provider training hinder AI implementation [8].

Summary of Findings and Practical Implications

Overview of the Data

AI has shown great potential in disease monitoring, clinical decision support, and behavioral interventions. Long-term success depends on equity, inclusivity, and stakeholder trust [2][6].

Implications for Policy and Practice

To scale AI effectively:

- Use diverse, high-quality datasets
- Build transparent, auditable models
- Train healthcare workers adequately
- Ensure community engagement in design and implementation [7][8]

DISCUSSION-

The review advocates:

- Data equity through representative datasets
- Bias checks and continuous validation
- Ethical standards similar to clinical trials [7]
- Professional education in AI and ethics
- Independent ethical oversight for local implementations
- Open-source platforms to enhance interoperability [8]
- Public trust through transparency, explainable models, and community involvement

CONCLUSION-AI holds great promise for transforming public health, especially in resource-limited settings. However, success depends on ethical integration, inclusive design, infrastructure development, and skilled personnel. AI should complement—not replace—healthcare providers, enabling equitable and responsive public health systems.

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