

AI in preventive healthcare: Opportunities and challenges

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Abstract

Chronic diseases—including cardiovascular disease, cancer, chronic obstructive pulmonary disease, diabetes, and depression—continue to rise globally, largely driven by modifiable behavioural risk factors. An estimated 40% of premature deaths are attributable to preventable behaviours such as smoking, unhealthy diets, and physical inactivity.¹ Preventive healthcare aims to identify risk early and intervene before disease onset or progression, thereby reducing morbidity, mortality, and costs. Artificial intelligence (AI) is increasingly positioned as a scalable enabler of preventive care via predictive analytics, automated risk stratification, conversational agents, and digital therapeutics. This narrative review synthesises the opportunities and challenges of AI in preventive healthcare, with illustrative examples of real-world tools (Ada Health, Lark Health Coach AI, GECA, Dejal@bot, and CoachAI). We highlight AI's promise for earlier detection, faster and more consistent decision support, and enhanced outreach and behaviour change interventions, while critically examining barriers including non-representative data, bias, calibration and generalisability limitations, privacy and security risks, and the “black-box” problem that undermines clinical trust. Responsible integration of AI into preventive care requires robust governance, transparent evaluation, equity-oriented data strategies, and clinician oversight to ensure safety, effectiveness, and public confidence.

Keywords: Artificial intelligence; Preventive healthcare; Chronic disease prevention; Digital health; Machine learning; Chatbots

1. Introduction

The global burden of chronic disease has increased substantially over recent decades. Cardiovascular disease, cancer, chronic obstructive pulmonary disease (COPD), diabetes, arthritis, and depression are increasingly prevalent and contribute disproportionately to disability, healthcare utilisation, and premature mortality. Behavioural determinants—particularly smoking, obesity, harmful alcohol intake, unhealthy diet, and sedentary lifestyle—are widely recognised as key upstream drivers of this burden.¹ Smoking, obesity, alcohol consumption, and physical inactivity are associated with earlier onset of chronic disease, multimorbidity, and premature death; compared with individuals without behavioural risk factors, those with two or more risk factors may experience an average reduction in life expectancy of approximately 12 years.²

Preventive healthcare addresses this challenge by identifying risk factors early, detecting disease at pre-symptomatic stages, and implementing interventions that reduce the likelihood of progression to advanced illness.^{3,4} Prevention includes vaccination, lifestyle modification, dietary improvement, screening, and early management of risk conditions. Prevention of disease and complications is among the most fundamental functions of primary care; when delivered effectively, preventive care can reduce morbidity and mortality for both chronic and acute conditions.⁵ Additionally, preventive services can reduce system-level costs by averting complex, late-stage interventions.⁴

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While behavioural coaching remains an effective cornerstone of prevention, scaling preventive care within overstretched systems increasingly depends on technology-enabled models. Technology-driven health communication—including automated outreach, chatbots, and SMS—can improve adherence to preventive screening and engagement with services.⁴ In this context, artificial intelligence (AI) has emerged as a potentially transformative capability that can support early risk identification, personalised prevention plans, and efficient population-level prevention programmes.^{5, 6, 8}

This narrative review provides an overview of AI applications in preventive healthcare, focusing on opportunities, practical tools, and the key technical and ethical challenges that must be addressed for safe and equitable implementation.

2. Artificial Intelligence in Healthcare and Preventive Care

AI describes the capability of computer systems to perform tasks commonly associated with human intelligence, including learning, reasoning, pattern recognition, and language processing.⁷ AI is now widely applied in medicine, with adoption accelerating across diagnostics, documentation, decision support, and workflow optimisation. In 2023, nearly 700 AI-enabled devices were authorised by the U.S. Food and Drug Administration across multiple specialties, highlighting the scale and momentum of clinical AI.⁶

AI systems support preventive care through several mechanisms: machine learning models learn patterns in structured and unstructured health data; natural language processing extracts meaning from clinical text; and large language models enable conversational interfaces and automated content generation.⁸ AI algorithms can accelerate diagnostics, improve consistency, and streamline care processes through predictive analytics, image recognition, and language-based systems.⁸ These functions align closely with preventive care goals—particularly early detection, proactive intervention, and personalised health guidance.

Common preventive applications include patient-facing chatbots, continuous monitoring via Internet of Things (IoT) devices (e.g., smartwatches), automated reminders for medications and healthy behaviours, and AI-powered imaging tools that detect early disease signals on radiographs, CT, or MRI scans.⁸

3. Illustrative AI Tools in Preventive Healthcare

Ada Health (AI Symptom Assessment)

Ada Health is a Berlin-based digital health platform that provides AI-driven symptom assessment and condition suggestions. It is available in 148 countries, supports 11 languages, and has over 13 million users.¹¹ By providing preliminary assessment and encouraging timely medical consultation, symptom checkers may support earlier detection and appropriate help-seeking.¹³ Ada is also positioned as a mechanism for reducing access inequities by providing scalable health guidance to underserved populations.¹² Evidence cited in platform evaluations suggests Ada's top-three suggestion accuracy may outperform competitors, with advice deemed safe in most cases and comparable to general practitioners.¹³

3.1. Lark Health Coach AI (Lifestyle and Weight Management)

Effective chronic disease prevention and management—particularly in diabetes—depends heavily on education, sustained behaviour change, and self-management.¹⁴ Lark Health Coach AI is a conversational platform designed to provide personalised coaching on diet, exercise, sleep, and stress management. It delivers structured modules (e.g., self-monitoring, goal-setting, action planning) and ongoing text-based counselling.¹⁵ Such interventions illustrate how conversational AI may support scalable preventive coaching and sustained engagement over time.

3.2. GECA (Guidance and Engagement Chatbot Assistant)

GECA is a preventive care chatbot developed within the iCare4NextG platform, designed to deliver guidance, monitoring, and early warning alerts for patients receiving home-based care.⁹ It supports English and European Portuguese and can integrate with external systems such as medical devices and prescription tools.⁹ GECA can identify abnormal parameters (e.g., temperature, heart rate), prompt adherence to medications, and recommend actions when deterioration is detected. In dementia care, GECA incorporates cognitive exercises to monitor decline and suggest clinical review when appropriate.⁹ Reported performance indicates a high rate of correct responses in testing, supporting its feasibility as a preventive monitoring and engagement tool.⁹

3.3. Dejal@bot (Smoking Cessation)

Dejal@bot is a Spanish-language conversational chatbot developed to support smoking cessation, tested in a pragmatic, multicentre randomised controlled trial across 34 primary care centres in Madrid.¹⁶ The intervention delivered behavioural counselling via Telegram using the evidence-based 5A framework (Ask, Advise, Assess, Assist, Arrange), supplemented with multimedia content and motivational engagement strategies.¹⁶ Trial findings demonstrated improved cessation outcomes relative to usual care, indicating that automated behavioural support can be effective where in-person support is constrained.¹⁶

3.4. CoachAI (Conversational Health Coaching)

CoachAI is a conversational agent designed to promote lifestyle change—improving diet and physical activity to reduce obesity and cardiometabolic risk—using behavioural theory frameworks such as motivational interviewing and the Transtheoretical Model.¹⁰ It has been deployed in real-world interventions (e.g., gym-based weight loss programmes), delivering reminders and motivational messaging via WhatsApp.¹⁰ Reported findings suggest improved engagement and reduced dropout rates, supporting AI's role as an adjunct that complements human coaching and increases scalability.¹⁰

4. Methods (Narrative Review Approach)

A narrative literature review was undertaken using PubMed, PubMed Central, Google Scholar, and ResearchGate. Search terms combined “artificial intelligence” with “preventive care,” “patients in preventive care,” and “role of AI in preventive care.” Non-English publications, studies not focused on preventive care applications, and abstracts without accessible full text were excluded. No restriction was applied to earliest publication date. Manual searches were conducted to refine definitions and identify key case studies, with ResearchGate assisting access to full texts where available.

5. Discussion

5.1. Opportunities of AI in Preventive Healthcare

5.1.1. Disease Prediction and Risk Stratification

A key preventive objective is to detect risk before symptom onset. Improved electronic record systems, combined with AI analytics, enable identification of patterns that may predict future disease. AI can analyse large datasets and detect non-linear correlations that are difficult for human reviewers to identify, enabling earlier risk stratification and targeted interventions.^{17, 18} Such prediction can support clinician recommendations on lifestyle change (diet, exercise, smoking cessation) and prioritisation of screening and follow-up.

5.1.2. Faster Diagnosis and Earlier Detection

AI-enabled diagnostic systems can improve speed and consistency by automating aspects of detection and interpretation, including image analysis. Deep learning methods can extract disease-related patterns from medical imaging and other high-dimensional datasets, supporting earlier diagnosis of conditions such as cancer and cardiovascular disease.¹⁷ By reducing diagnostic delays and potentially lowering false positives and misdiagnoses, AI can enhance preventive care decision-making and improve patient outcomes.¹⁹

5.1.3. Digital Therapeutics and Behaviour Change Support

Digital therapeutics—software-based interventions grounded in evidence-based medicine—can prevent, treat, or manage disease and high-risk factors.¹⁴ AI-enabled digital therapeutics can provide continuous, personalised coaching and feedback, bridging the gap between population evidence and individual behavioural support.²⁰ The growing body of evidence on chatbots for chronic disease self-management (e.g., diabetes) underscores their role in supporting sustained engagement and behavioural adherence.¹⁴

5.1.4. Improved Access to Preventive Services

Technology-driven communication tools can enhance outreach and adherence to preventive screening and monitoring.⁴ Digital health interventions designed for primary care prevention show promise in supporting behaviour change, reminders, and coordination, particularly at scale.⁵ AI-enabled systems may be especially valuable in settings facing shortages of clinicians and limited access to preventive services.

6. Challenges of AI in Preventive Healthcare

Despite progress, AI implementation faces intertwined technical, ethical, and operational challenges affecting healthcare professionals and patients.¹⁷ Safety challenges remain central, particularly where AI outputs may influence clinical decisions.⁶ The literature commonly distinguishes reliability challenges (performance robustness) from alignment challenges (fit with human goals, values, and clinical reasoning).⁶

6.1. Inadequate or Non-Representative Data and Bias

AI performance is constrained by the quality, breadth, and representativeness of training data. In many low- and middle-income settings, limited adoption of electronic health records reduces available datasets, increasing the risk that AI systems underperform for underrepresented populations.⁶ Models trained on narrow datasets often demonstrate limited generalisability.⁶ Biased data collection can lead to discrimination, reduced accuracy, and widening of health inequalities.¹⁷ Evidence from retinal image analysis illustrates how error rates can increase substantially when models are tested on data from different vendors or populations than those used for training.⁶

6.2. Reliability: Harmonisation, Calibration, and Generalisation

Reliable AI requires harmonised data standards, robust calibration, and generalisation across settings and populations. Data harmonisation is challenging due to inconsistent terminologies, measurement units, documentation standards, and variations in data quality.⁶ Calibration is further complicated by differences in disease prevalence, clinical pathways, and evolving medical knowledge, making stable cross-context performance difficult.⁶ Generalisation failure can arise through overfitting, underfitting, population shift, and temporal drift, resulting in reduced reliability when deployed outside the training environment.⁶

6.3. Transparency, Trust, and “Black Box” Models

Many AI systems—especially deep learning models—operate as “black boxes,” limiting explainability. This opacity undermines clinician trust and complicates responsible integration into preventive care.⁶ When clinicians cannot understand why a model produced a recommendation, appropriate oversight becomes difficult, and adoption may stall. Patient acceptance may also decrease if AI-driven advice is not clearly justified.

6.4. Ethical, Legal, and Privacy Risks

Preventive AI frequently requires access to sensitive data such as electronic health records, genetic information, and continuous monitoring outputs. Concerns about privacy breaches, unauthorised access, and secondary use of health data are increasingly prominent.^{6,17,20,21} Ethical questions include responsibility for AI-related harms, informed consent, transparency, fairness, and accountability.¹⁸ Implementing AI in practice raises unresolved ethical issues, particularly where data is treated as “capital” and commercial incentives may conflict with patient interests.²⁰ The growing scale of remote monitoring expands risks of misuse, including potential sharing with third parties without consent.²¹ Robust privacy safeguards, secure storage and processing, and compliance with regulations are essential for maintaining public trust and reducing harm.¹⁹

7. Conclusion

AI has substantial potential to enhance preventive healthcare through earlier risk detection, faster diagnostic support, scalable behavioural interventions, and improved outreach and adherence mechanisms.^{4,5,8-10,14} However, the effective use of AI in prevention depends on overcoming major limitations related to data quality and representativeness, reliability across populations and time, transparency and trust, and ethical and privacy protections.^{6,17-21} To maximise benefit and minimise harm, AI should be implemented as an adjunct to clinical care with strong governance, equity-oriented evaluation, and clinician oversight—supporting preventive healthcare systems while preserving accountability and patient-centred values.

Compliance with ethical standards

Disclosure of conflict of interest

The author declares that there is no conflict of interest in the publication of this article

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