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EDITORIAL

AI and Machine Learning in Clinical Practice: Promise vs. Reality

Prakash Patel[1]

[1]Chief Editor, IJMR

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The coming of artificial intelligence (AI) and machine learning (ML) is creating big excitement in medical field, promising for transforming clinical practice into more precise, efficient and patient-centric endeavor. Visions of AI-driven diagnostics which is outperforming human experts, personalized treatment plans that is tailored to individual genetics, and predictive analytics foreseeing health crisis before they are occurring is dominating headlines and research agendas. But, as we are standing in 2025, gap between these big promises and ground reality of daily clinical workflows is remaining stark. This editorial is exploring contradiction, drawing on recent evidences to argue that while AI is having transformative potential, its integration is demanding cautious, evidence-based approach for overcoming persistent barriers. Without addressing these, hype is risking to undermine trust in both technology and healthcare providers.

PROMISES OF AI AND ML IN CLINICAL PRACTICE

Basically, the attraction of AI and ML is lying in their ability for processing vast data's far beyond human capacity, uncovering patterns which is enhancing diagnosis, treatment and prevention. In diagnostics, ML algorithms are showing very good accuracy in interpretation of medical images. For example, deep learning models is matching dermatologists, even surpassing at some time, in detecting skin cancers and showing better sensitivity in detecting early breast cancer from mammograms, one study reported 91% sensitivity compared to 74% for radiologists [1]. Similarly, AI is surpassing in analyzing retinal scans for diabetic retinopathy, pivotal trials validating autonomous systems in primary care settings [2]. These tools are promising to reduce false positives and negatives, potentially saving lives through early interventions.

Beyond diagnostics, AI's predictive capabilities are outstanding in personalized medicine. By analyzing electronic health records (EHR), genetic data and environmental factors, ML is predicting disease progression and treatment responses. One prominent example is predicting chemotherapy efficacy with over 80% accuracy using gene expression profiles from cancer patients, enabling customized patient specific regimens which is minimizing side effects [1]. In mental health, AI-driven precision tools are aiming to deconstruct biopsychosocial complexities, improving nosology and preventive strategies [3]. For chronic conditions like multiple sclerosis (MS), AI is enhancing MRI study by segmenting lesions and identifying biomarkers, like central vein sign, for refining diagnosis and prognosis [4].

Operational efficiencies are representing another key promise. AI is automating repetitive tasks, such as transcribing patient conversations or optimizing scheduling, freeing clinicians for more meaningful interaction. Chatbots like NHS's AI tool is triaging millions, answering queries 24/7, while virtual assistants in ICUs is monitoring patients autonomously [1]. In population health, predictive analytics identify at-risk individuals for chronic diseases, as seen in tools analyzing Twitter data's to map disease prevalence in regions [1]. McKinsey is estimating AI can add $100 billion annually to US healthcare through such applications, reducing costs and errors [1]. Overall, these promises are painting future where AI is augmenting human intelligence, reducing cognitive burden and enabling equitable, high-quality cares.

REALITY: CHALLENGES AND PITFALLS

Despite these attractive prospects, reality of AI in clinical practice is fraught with hurdles which is tempering enthusiasm. Primary challenge is evidence gap; many algorithms is excelling in controlled settings but faltering in real-world applications. Systematic reviews are revealing that only fraction of studies is validating models externally or comparing them to clinicians, with poor reporting and weak validation standards prevalent [2]. For example, Google algorithm for diabetic retinopathy underperformed in poorly lit clinics, highlighting data quality and environmental mismatches [2].

Bias is remaining prevalent issue, increasing differences if training data's is lacking diversity. A 2019 study exposed commercial algorithm's bias against Black patients, using cost as proxy for need and resulting in reduced care for equally sick individuals [5]. In ML processes, bias can affect population selection, variable derivation and predictions, demands ongoing monitoring [6]. Ethical concerns are extending to privacy, with vast data requirements rising risks of breaches despite regulations like HIPAA and GDPR [1].

Integration into workflows is posing practical barriers. EHR interoperability is limited, varying data formats hindering deployment [7]. Models are often prioritizing predictive accuracy over clinical utility, as seen in post-acute care prediction tool with high AUC but low positive predictive value, leading to inefficiencies [7]. In perioperative medicine, while ML is predicting complications like intraoperative hypotension, non-technical issues like oversight policies and costs is slowing adoption [7].

Public trust is lagging, surveys showing 60% Americans uncomfortable with AI in their care, and familiarity low at 25% [5]. Generative AI's "hallucinations" fabricating information's further erodes confidence in high-stake environments [5]. Scalability is limited; most implementations is institution-specific, broader adoption stymied by regulatory, financial and equity concerns [8].

BRIDGING GAP: TOWARD REALISTIC FUTURE

For moving from promise to practice, interdisciplinary collaboration is essential. Clinicians, data scientists and ethicists must co-develop models aligned with clinical needs, emphasizing transparency and explainability [3]. Initiatives like multicenter data warehouses is standardizing inputs, aiding validation [7]. Real-world examples are offering hope: Geisinger's ML-driven colonoscopy outreach detected cancer in 8% participants, while Beth Israel's AI optimized opioid prescribing [8]. Regulatory frameworks, like FDA guidelines, is evolving, but faster progress requires investment in unbiased datasets and responsibility models [1]. Education for providers and patients will build trust, ensuring AI is augmenting rather than replacing human judgement.

CONCLUSION

AI and ML in clinical practice is symbolizing exciting promise of transformed healthcare, yet reality is indicating a tempered expectation. By challenging biases, enhancing integration and prioritizing ethical deployment, we can integrate these technologies for genuine benefit. Path forward is lying not in hype, but in rigorous, collaborative innovation which is placing patients at centre.

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