Editorial

Artificial Intelligence in Predicting, Diagnosing and Preventing Sexually Transmitted Infections (STIs)

Jyoti Taneja [1,†], Joyeta Ghosh [2,†], Ravi Kant [3] and Myron Christodoulides [3,*]

1   Department of Zoology, Daulat Ram College, University of Delhi, Delhi 110007, India; jyotitaneja@dr.du.ac.in
2   Department of Dietetics and Applied Nutrition, Amity Institute of Applied Sciences (AIAS), Amity University, Kolkata Campus, Kolkata 700135, West Bengal, India; jghosh@kol.amity.edu
3   Molecular Microbiology, School of Clinical and Experimental Sciences, Faculty of Medicine, University of Southampton, Southampton SO17 1BJ, UK; r.kant@soton.ac.uk
*   Correspondence: mc4@soton.ac.uk
†   These authors contributed equally to this work.

Sexually transmitted infections (STIs) are major global health challenges, disproportionately affecting women due to complex biological, social and economic factors. These factors contribute to delayed diagnoses and increase the risk of severe complications, including pelvic inflammatory disease, infertility and vertical transmission from mother to child. According to the World Health Organization (WHO) [1], about one million people acquire STIs daily, with the Centers for Disease Control and Prevention reporting nearly 68 million cases in the United States alone, imposing a direct medical cost approaching USD 16 billion annually [2]. More than 374 million new cases of curable STIs, i.e., chlamydia, gonorrhea, syphilis and trichomoniasis occur annually, and almost 50% of the infected population is in the younger age group [1]. Despite widespread awareness campaigns, the Global Burden of Disease Study (https://ghdx.healthdata.org/gbd-2019, accessed on 25 March 2025) reported a rising trend in STIs worldwide, driven by socio-demographic disparities, social stigma, behavioral practices and limited access to timely healthcare. Despite prevention awareness, the paradoxical increase in STI rates has been attributed to changing sexual behaviors, reduced condom use [3] and the proliferation of dating applications that facilitate casual sexual encounters [4,5].

Traditional epidemiological approaches, which rely on self-reported data and symptomatic diagnoses, often lead to underreporting and misclassification of STIs, highlighting the urgent need for more robust and predictive tools. Artificial intelligence (AI) and machine learning (ML) have already revolutionized various aspects of healthcare, and their role in infectious disease management, particularly in STIs, is rapidly evolving. AI-driven models have the potential to predict STI risk amongst women with unprecedented accuracy by leveraging complex big data.

1. The Role of AI in STI/RTI Prediction and Public Health

Advances in AI and ML offer a transformative approach to STI prediction, detection and prevention. These technologies can analyze vast datasets, including electronic health records, genomic information, behavioral surveys and social determinants of health, to generate personalized risk profiles that traditional methods may overlook. AI-powered predictive models can (1) identify high-risk individuals before infection manifestation; (2) analyze large-scale epidemiological trends to guide public health policies; (3) enhance early intervention strategies by integrating clinical, demographic and behavioral data; and (4) improve precision medicine approaches for STI management. Future directions include multimodal data integration from genomic sources and wearable technologies, real-time

adaptive interventions and expansion beyond narrow STI diagnosis to comprehensive sexual health management. By shifting from reactive to proactive approaches, AI and ML technologies offer unprecedented opportunities to improve reproductive health outcomes for women worldwide, provided that implementation addresses ethical considerations and healthcare integration challenges [6]. Different ML techniques offer unique advantages in STI prediction, e.g., supervised learning models (SLM) assess individual risk factors, while deep learning (DL) techniques analyze complex genetic and behavioral data, and natural language processing (NLP) enhances real-time STI monitoring by analyzing clinical notes, online health discussions and public health reports.

2. Challenges in Implementing AI for STI Risk Prediction

The knowledge about reproductive health and STIs is poor, with many individuals unaware of preventive habits, risk factors and early symptoms. Even with awareness, many individuals do not carry out self-examination regularly, and societal taboos, limited healthcare access and risk factors contribute to high rates. AI implementation faces critical challenges including patient privacy concerns, the potential exacerbation of existing health disparities through digital divides [7] and the necessity for seamless clinical integration. Sendak et al. [8] emphasized the importance of rigorous validation studies with diverse populations, user-centered design principles and continuous performance monitoring, which are essential conditions for the responsible deployment of AI/ML in sexual and reproductive health. However, to maximize AI's potential, key challenges relating to privacy concerns, algorithmic bias and equitable healthcare access must be addressed. A holistic approach, including behavioral interventions, vaccine development, AI-assisted risk prediction, improved diagnosis, prevention and public health policies, is necessary to combat STIs effectively.

3. Role of AI in STI Diagnosis

The landscape of STI diagnosis is evolving rapidly with advances in AI and ML. Traditional diagnostic methods, such as laboratory-based testing and clinical examinations, remain essential, but they often require specialized infrastructure, trained personnel and time-consuming sample processing. AI-driven innovations offer new possibilities for early detection, remote screening and enhanced diagnostic accuracy, particularly in resource-limited settings. AI-powered diagnostic approaches are particularly promising for addressing dermatological manifestations of STIs, optimizing mobile health applications and improving clinical decision support systems. These advances are set to revolutionize STI screening by making it more accessible, efficient and precise. By integrating cutting-edge technologies with traditional healthcare infrastructure, AI has the potential to transform STI management, making prevention and treatment more personalized, accessible and effective, particularly for women facing barriers to healthcare access and stigma.

4. Future Directions: AI's Role in Personalized Sexual Health Management

The future of AI in sexual health is not just about disease prevention: it is about empowering individuals with the knowledge, resources and support for a healthier, more informed and stigma-free future. By leveraging AI for real-time STI tracking and outbreak prevention, public health agencies will be better equipped to predict, prevent and manage STI epidemics worldwide. Future AI-driven healthcare systems will incorporate multimodal data integration, enable real-time adaptive interventions and move toward a holistic approach to sexual health. AI will also facilitate hybrid clinician/researcher–AI collaboration, enhance real-time global STI surveillance and enable personalized risk assessments. By shifting from reactive to proactive approaches, AI can empower individuals

to make informed decisions about their sexual and reproductive health, leading to better STI prevention, early detection and improved treatment outcomes.

5. Summary

AI has the potential to revolutionize STI/RTI management by providing personalized, data-driven and accessible solutions for early detection, risk assessment and treatment. However, ethical considerations, such as data privacy, algorithmic fairness and healthcare equity, must be carefully addressed to maximize AI's impact. By integrating AI into existing healthcare infrastructure, we can enhance STI prevention efforts, reduce transmission rates and ultimately improve reproductive health outcomes for women worldwide. The future of AI in sexual health is not just about disease prevention: it is about empowering individuals with the knowledge, resources and support for a healthier stigma-free future.

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