

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

ARTIFICIAL INTELLIGENCE FOR EARLY DETECTION OF CERVICAL CANCER: EVIDENCE-BASED DIAGNOSTIC SUPPORT AND A PROPOSED AI MODEL FOR UZBEKISTAN

Hasanova Mahliyo Husanboy qizi
Family Polyclinic No. 65, Tashkent, Uzbekistan
+99891-492-37-97
Xasanovamahliyo872@gmail.com

Abstract

Cervical cancer remains a major public health problem despite the availability of effective screening and preventive strategies. Artificial intelligence (AI) has increasingly been investigated as a tool for automated cytological interpretation, colposcopic image assessment, risk stratification, and clinical decision support. However, high diagnostic performance reported in individual studies cannot automatically be interpreted as evidence of clinical readiness because performance may vary according to population characteristics, disease prevalence, reference standards, imaging modalities, datasets, algorithms, and external validation procedures.

This study aimed to critically synthesize available evidence on AI-assisted detection of cervical intraepithelial neoplasia and cervical cancer and to develop a clinically interpretable AI implementation framework adapted to the healthcare context of Uzbekistan. The analysis was based primarily on published systematic reviews and meta-analyses rather than on an original patient cohort. Particular attention was given to sensitivity, specificity, positive and negative predictive values, area under the receiver operating characteristic curve (AUC), pooled odds

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

ratios, and between-study heterogeneity. A major systematic review and meta-analysis including 77 studies reported pooled sensitivity and specificity of 95% and 94%, respectively, for AI-assisted Pap-smear assessment, and 97% and 94% for ThinPrep cytology. For AI-assisted colposcopy, pooled sensitivity and specificity were 86% and 83%, respectively. AI demonstrated higher diagnostic performance than experienced colposcopists in the pooled comparison (OR 1.75, 95% CI 1.33–2.31), although substantial heterogeneity was observed. More recent evidence involving 97 studies indicates that AI-assisted colposcopic diagnosis currently has the most mature evidence base, whereas AI-based triage of high-risk HPV-positive women remains comparatively underdeveloped.

The scientific contribution of this paper is not the generation of new clinical diagnostic estimates, but the integration of existing quantitative evidence into a structured clinical decision-support framework and the development of a proposed multimodal AI model for Uzbekistan. The proposed model combines primary HPV screening, AI-assisted cytology, standardized colposcopic image analysis, clinical variables, and histopathological confirmation. The model emphasizes external and prospective validation, calibration, subgroup analysis, explainability, and human oversight. The findings suggest that AI should currently be positioned as a clinical decision-support technology rather than an autonomous diagnostic system.

Keywords: Artificial intelligence; cervical cancer; cervical intraepithelial neoplasia; cervical cytology; Pap smear; ThinPrep; colposcopy; HPV; machine learning; diagnostic accuracy; clinical decision support; Uzbekistan.

Introduction

Cervical cancer is one of the most preventable malignant diseases because persistent infection with high-risk human papillomavirus (HPV) can be identified before invasive cancer develops. Contemporary cervical cancer prevention

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

therefore depends not only on treatment but also on effective screening, triage, diagnosis, and timely referral. The World Health Organization (WHO) has placed HPV-based screening at the centre of cervical cancer prevention strategies and recommends organized approaches that connect screening with appropriate triage, diagnosis, and treatment.

Despite these advances, the diagnostic pathway remains vulnerable to several limitations. Cytological interpretation requires trained personnel, image quality can vary, and colposcopic assessment is influenced by the experience of the examiner. These factors create an opportunity for computational methods capable of recognizing morphological patterns that may be difficult to identify consistently through visual inspection alone.

Artificial intelligence, particularly machine learning and deep learning, has consequently become an important research direction in cervical cancer screening. AI systems have been investigated for cervical cytology classification, segmentation of abnormal regions, automated recognition of cervical lesions, colposcopic image interpretation, and clinical risk prediction.

However, the interpretation of AI evidence requires methodological caution. A model achieving high accuracy on a retrospective image dataset does not necessarily demonstrate clinical usefulness. Diagnostic performance may decline when the model is transferred to another hospital, population, imaging device, staining protocol, or disease-prevalence environment. Consequently, sensitivity and specificity should be interpreted together with confidence intervals, AUC, predictive values, heterogeneity, calibration, external validation, and clinical consequences.

A systematic review and meta-analysis by Liu et al. included 77 studies and demonstrated high pooled performance of AI-assisted cervical cytology and colposcopy. For AI-assisted Pap-smear analysis, pooled sensitivity was 95% and specificity 94%, while corresponding estimates for ThinPrep cytology were 97%

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

and 94%. AI-assisted colposcopy showed pooled sensitivity of 86% and specificity of 83%.

Nevertheless, the same evidence base demonstrated substantial statistical heterogeneity. This is particularly important because a high pooled estimate may conceal considerable variation between individual studies.

More recent evidence has further refined this interpretation. A 2026 role-stratified systematic review and bivariate meta-analysis identified 97 eligible studies, of which 47 provided data suitable for pooled analysis. Diagnostic assistance during colposcopy showed the most mature evidence, with pooled sensitivity of 0.908, specificity of 0.844, and HSROC AUC of 0.94. In contrast, AI-based triage of high-risk HPV-positive women represented a much smaller evidence base, indicating an important unresolved clinical research gap. External validation was reported in only 10.9% of studies.

Therefore, the central research problem is no longer simply whether AI can classify cervical abnormalities. The more important question is:

How can existing AI evidence be transformed into a clinically interpretable, externally validated, multimodal diagnostic decision-support pathway suitable for implementation in Uzbekistan?

The aim of this study was therefore to critically synthesize quantitative evidence concerning AI-assisted cervical cancer detection and, based on that evidence, propose a scientifically grounded AI-supported diagnostic model adapted to the healthcare context of Uzbekistan.

Materials and Methods

Study design

This paper was designed as an evidence-based analytical review and clinical implementation framework study. It did not constitute an original diagnostic accuracy study and did not use a newly collected patient cohort. Therefore, no original patient-level sensitivity, specificity, or predictive values were calculated.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

The quantitative findings were derived primarily from published systematic reviews and meta-analyses of AI-assisted cervical cytology and colposcopy. The purpose of the present analysis was to critically interpret those pooled estimates and translate them into a proposed clinical AI architecture.

This distinction is essential because presenting pooled estimates from published meta-analyses as newly generated clinical results would constitute methodological misrepresentation.

Evidence sources

The evidence base focused on:

1. systematic reviews and meta-analyses of AI-assisted cervical cancer diagnosis;
2. studies evaluating AI-assisted cervical cytology;
3. studies evaluating AI-assisted colposcopy;
4. machine-learning models using clinical or epidemiological variables;
5. methodological standards for AI-based clinical prediction models;
6. international cervical cancer screening recommendations.

The principal quantitative evidence was obtained from the systematic review and meta-analysis by Liu et al., which searched PubMed, Embase, and the Cochrane Library for studies published between January 1, 1986 and August 31, 2024.

WHO cervical cancer screening recommendations were used to ensure that the proposed AI pathway remained consistent with the contemporary principle of HPV-based screening and appropriate triage.

The methodological interpretation of clinical AI models was additionally informed by the TRIPOD+AI reporting framework, which provides updated guidance for prediction models developed using regression or machine-learning approaches.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaopenaccess.com/index.php/5>

Eligibility logic

Evidence was considered relevant when it addressed:

- AI or machine-learning methods applied to cervical cancer or cervical intraepithelial neoplasia;
- cytological or colposcopic images;
- clinically relevant diagnostic outcomes;
- histopathological or clinically accepted reference standards;
- diagnostic performance measures;
- systematic reviews or meta-analyses providing quantitative synthesis.

Studies focused exclusively on technical image processing without a clinically meaningful diagnostic endpoint were considered less relevant to the clinical implementation analysis.

Reference standard

A central methodological principle was the distinction between AI classification and clinical diagnosis.

For diagnostic accuracy research, histopathological assessment of biopsy or excisional material provides an important reference standard for clinically significant cervical intraepithelial neoplasia and invasive cancer. Therefore, the proposed Uzbekistan model places histopathological confirmation downstream of AI-assisted risk assessment rather than allowing the AI output to function as an independent final diagnosis.

3. Statistical Analysis

The diagnostic performance of artificial intelligence (AI) systems was assessed using the main diagnostic accuracy indicators, including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the area under the receiver operating characteristic curve (AUC). These indicators were

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

considered together to provide a more comprehensive assessment of the clinical performance of AI-based diagnostic systems.

Sensitivity reflects the ability of an AI system to correctly identify patients with cervical intraepithelial neoplasia or cervical cancer, whereas specificity indicates its ability to correctly classify patients without the target condition. PPV represents the probability that a patient classified as positive by the AI system actually has the disease, while NPV represents the probability that a patient classified as negative is truly disease-free.

The AUC was used to evaluate the overall discriminatory ability of the diagnostic model across different classification thresholds. Higher AUC values indicate better discrimination between patients with and without clinically significant cervical lesions.

Between-study heterogeneity was assessed using the I^2 statistic. In general, higher I^2 values indicate greater variability among the included studies that cannot be explained solely by sampling error. In AI-based cervical cancer research, heterogeneity may result from differences in patient populations, disease prevalence, HPV status, imaging techniques, image quality, AI algorithms, reference standards, and validation strategies.

Where comparative diagnostic performance was available, the pooled odds ratio (OR) was also considered. An OR greater than 1 indicates higher odds of the evaluated diagnostic outcome in the AI group compared with the reference group. However, the OR was interpreted together with its 95% confidence interval and the level of heterogeneity rather than being considered as an independent measure of clinical superiority.

A random-effects model was considered appropriate for interpreting pooled diagnostic estimates because the included studies differed substantially in populations, technologies, clinical settings, and methodological characteristics. Statistical significance was interpreted using the 95% confidence interval and corresponding p-value where these were reported in the original meta-analyses.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

Importantly, the present study did not calculate new patient-level diagnostic statistics because it was based on previously published systematic reviews and meta-analyses rather than an original clinical dataset. Therefore, all numerical estimates presented in the Results section are reported as previously published pooled estimates.

4. Results. Quantitative evidence from AI-assisted cervical diagnosis

The major systematic review and meta-analysis by Liu et al. included 77 studies and provided pooled estimates for AI-assisted cervical cytology and colposcopy.

Table 1. Pooled diagnostic performance of AI-assisted cervical cancer detection

Diagnostic application	Sensitivity	Specificity	Accuracy	PPV	NPV	AUC
AI + Pap smear	95% (91–98)	94% (89–97)	94% (92–96)	88%	95%	0.99
AI + ThinPrep	97% (95–99)	94% (85–98)	90% (85–94)	84%	96%	0.99
AI + colposcopy	86% (76–92)	83% (73–90)	81% (77–84)	—	—	—
Experienced colposcopists	85%	67%	74% (69–79)	—	—	0.85

The pooled results indicate strong discriminatory performance for AI-assisted cytological assessment. Nevertheless, the differences between modalities demonstrate that AI performance should not be represented as a single universal diagnostic value.

The strongest pooled sensitivity was observed for ThinPrep-based AI analysis, whereas colposcopic AI demonstrated lower pooled sensitivity and specificity but remains particularly relevant for real-time clinical decision support.

Heterogeneity as a major finding

The most important methodological result is the presence of substantial heterogeneity.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaoa.com/index.php/5>

For AI-assisted Pap-smear assessment, heterogeneity in sensitivity and specificity was approximately 99.8%. For ThinPrep analysis, heterogeneity was similarly extreme, reaching approximately 99.9–100% for some pooled parameters. Colposcopic AI also demonstrated substantial heterogeneity.

This finding changes the interpretation of the evidence.

The correct conclusion is not: “AI has approximately 95% diagnostic accuracy in all settings.”

Rather, the evidence supports: “AI demonstrates high pooled diagnostic performance under heterogeneous research conditions, but the transferability of these estimates to new populations and clinical settings requires external validation.”

This distinction is particularly important for countries such as Uzbekistan, where local population characteristics, laboratory workflows, imaging equipment, and clinical expertise may differ from the settings represented in published studies.

Discussion

The available evidence demonstrates that AI has substantial potential for cervical cancer screening and diagnosis. The 77-study meta-analysis reported high pooled sensitivity and specificity for AI-assisted cytology, while AI-assisted colposcopy also demonstrated clinically meaningful diagnostic performance.

However, the high heterogeneity observed across studies represents a fundamental limitation. Diagnostic performance depends on the characteristics of both the data and the clinical environment. A model trained on high-quality images from a narrowly selected population may perform substantially differently when applied to routine clinical images from another country.

This issue is particularly important for Uzbekistan. Direct transplantation of a foreign AI model cannot be assumed to produce equivalent performance in Uzbek clinical practice.

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

Three types of validation are therefore particularly important.

First, **technical validation** should determine whether the model recognizes relevant visual patterns.

Second, **clinical validation** should establish whether the model accurately identifies clinically significant lesions in the intended patient population.

Third, **implementation validation** should determine whether AI improves clinical decision-making without increasing unnecessary referrals or delaying treatment.

Another important consideration is the difference between screening and triage. Recent evidence suggests that AI-assisted colposcopy currently has a relatively mature evidence base, whereas AI-assisted triage after a positive high-risk HPV result remains insufficiently studied.

Therefore, the scientific priority for future Uzbek research should not necessarily be the development of another standalone cytology classifier. A more valuable direction would be a **multimodal HPV–cytology–colposcopy risk model** validated prospectively across several healthcare institutions.

The model should also be evaluated for subgroup performance. Age, HPV genotype, menopausal status, lesion severity, image quality, and healthcare setting may influence performance. Such subgroup evaluation is necessary to avoid creating an algorithm that performs well only in a particular population.

Finally, explainability should be incorporated into the model. When AI identifies a high-risk lesion, the clinician should be able to see the image region contributing to the prediction. This does not make the model automatically correct, but it improves transparency and supports clinical review.

Conclusion

Artificial intelligence demonstrates substantial potential for improving cervical cancer screening and diagnostic decision support. Existing evidence indicates high pooled diagnostic performance for AI-assisted cytology and clinically

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

meaningful performance for AI-assisted colposcopy. However, the presence of substantial between-study heterogeneity means that pooled diagnostic estimates cannot be directly transferred to every population or healthcare system.

The proposed model positions AI as a decision-support technology rather than an autonomous diagnostic authority. Its successful implementation would require multicentre datasets, standardized image acquisition, histopathological reference standards, external validation, prospective clinical evaluation, subgroup analysis, calibration assessment, and transparent reporting.

References

1. Collins, G. S., Moons, K. G. M., Dhiman, P., Riley, R. D., Beam, A. L., Van Calster, B., Ghassemi, M., Liu, X., Reitsma, J. B., et al. (2024). TRIPOD+AI statement: Updated guidance for reporting clinical prediction models that use regression or machine learning methods. *BMJ*, 385, e078378. <https://doi.org/10.1136/bmj-2023-078378>
2. Liu, L., Liu, J., Su, Q., Chu, Y., Xia, H., & Xu, R. (2024). Performance of artificial intelligence for diagnosing cervical intraepithelial neoplasia and cervical cancer: A systematic review and meta-analysis. *EClinicalMedicine*, 80, 102992. <https://doi.org/10.1016/j.eclinm.2024.102992>
3. World Health Organization. (2021). WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention (2nd ed.). World Health Organization.
4. World Health Organization. (2021). WHO guideline for screening and treatment of cervical pre-cancer lesions for cervical cancer prevention: Use of mRNA tests for human papillomavirus (HPV). World Health Organization.
5. E.A.Alimova, E. (2026). TIBBIYOT INSTITUTLARIDA BIOFIZIKA FANINI O'QITISHDA KLINIK YO'NALTIRILGAN ZAMONAVIY INTERAKTIV YONDASHUVLAR. International Online Multidisciplinary

Eureka Journal of Health Sciences & Medical Innovation (EJHSMI)

ISSN 2760-4942 (Online) Volume 2, Issue 6, June 2026



This article/work is licensed under CC by 4.0 Attribution

<https://eurekaooa.com/index.php/5>

- Conference, 935–938. Retrieved from <https://tezislar.uz/index.php/iomc/article/view/815>
6. ISMANOVA, A. (2024). YOSHLARGA OID DAVLAT SIYOSATINI AMALGA OSHIRISHNING PEDAGOGIK TAHLILI. News of UzMU journal, 1(1.4), 104-108.
 7. ALIMOVA, E. T. (2025). BIOFIZIKA FANINI MULTIMEDIALI ELEKTRON VOSITALAR ASOSIDA O ‘QITISHNING DIDAKTIK IMKONIYATLARI. «ACTA NUUZ», 1(1.2. 1), 59-61.
 8. Alimova, E. (2026). THE CONTRIBUTION OF DIGITAL TECHNOLOGIES TO TEACHING BIOPHYSICS. International Online Multidisciplinary Conference, 947–949. Retrieved from <https://tezislar.uz/index.php/iomc/article/view/81>