

Editorial

Artificial Intelligence and Precision Oncology in Obstetrics and Gynecology: from Innovation to Responsible Implementation

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Artificial intelligence (AI) and precision oncology are increasingly converging in obstetrics and gynecology, particularly in the management of cervical, endometrial, ovarian, vulvar, and rare uterine malignancies. Gynecologic cancers are not uniform diseases defined solely by anatomic site; rather, they comprise biologically diverse entities with different molecular drivers, patterns of spread, therapeutic vulnerabilities, and outcomes. AI offers methods for recognizing complex patterns across clinical records, imaging, cytology, histopathology, and genomic data, while precision oncology seeks to translate these patterns into prevention, diagnosis, prognostication, and treatment tailored to individual patients.^{1,2} Their combined value lies not in replacing clinical judgment, but in making high-dimensional information interpretable and actionable at the point of care.

The most immediate opportunities are evident in image-intensive areas of gynecologic oncology. Machine-learning systems can support cervical cytology and colposcopy interpretation, tumor segmentation, radiomic assessment, digital pathology, prediction of lymph-node involvement, estimation of surgical complexity, and treatment-response modeling.² Recent work in cervical cytology has shown that AI can distinguish cytologic grades and invasive disease using large-scale image datasets, illustrating how automated systems may improve consistency and throughput when embedded within quality-assured screening pathways.³ Nevertheless, impressive accuracy in a curated dataset does not automatically translate into clinical benefit. Algorithms must be compared with existing standards, prospectively tested, externally validated across devices and populations, and evaluated for their effects on missed disease, unnecessary referrals, workload, cost, and patient outcomes.

Precision oncology is already reshaping routine classification in endometrial cancer. The 2023 International Federation of Gynecology and Obstetrics (FIGO) staging system incorporated histologic type and molecular classification, reflecting the prognostic relevance of POLE-mutated, mismatch repair-deficient, p53-abnormal, and no-specific-molecular-profile tumors.⁴ The updated ESGO-ESTRO-ESP guidance further embeds tumor biology within risk stratification and management, moving clinical decision-making beyond stage and grade alone.^{5,6} This transition is especially important for obstetrician-gynecologists because the quality of tissue acquisition, pathology reporting, immunohistochemistry, molecular testing, surgical staging, and referral determines whether patients can benefit from precision treatment. AI may accelerate interpretation and integration, but it cannot compensate for absent or unreliable diagnostic inputs.

The therapeutic consequences of biomarker-informed care are now clinically tangible. Phase III trials of pembrolizumab and dostarlimab combined with carboplatin-paclitaxel demonstrated substantial improvements in progression-free outcomes in patients with advanced or recurrent endometrial cancer, with particularly pronounced benefits in mismatch repair-deficient or microsatellite instability-high disease.^{6,7} These findings exemplify the precision-oncology principle: treatment selection is increasingly informed by tumor biology rather than histology alone. AI could help identify eligible patients, synthesize

longitudinal evidence, flag discordant results, and support multidisciplinary tumor boards. However, treatment recommendations must remain traceable to validated biomarkers, contemporary guidelines, patient preferences, comorbidities, fertility considerations, toxicity, access, and cost.

Responsible implementation is therefore as important as technical performance. A model that performs well in one tertiary center may deteriorate when applied to different scanners, staining protocols, populations, referral patterns, or disease prevalence. Bias can be amplified when underrepresented patients are missing from training datasets, while opaque outputs can undermine informed consent and professional accountability. The World Health Organization has emphasized transparency, safety, inclusiveness, privacy, human oversight, and accountability as central principles for AI in health.⁸ In gynecologic oncology, these principles require clear intended-use statements, audit trails, cybersecurity safeguards, post-deployment surveillance, mechanisms for clinician override, and explicit responsibility when algorithmic advice conflicts with the clinical picture.

For Indonesia, the path forward should build on existing strengths rather than import technology without local validation. The TeleDoVIA experience published in the *Indonesian Journal of Obstetrics and Gynecology* demonstrates that standardized cervical images and remote expert consultation can extend screening support in lower-resource settings and provide a practical foundation for future AI-assisted triage.⁹ Indonesian reports of rare gynecologic malignancies also demonstrate the continuing importance of multidisciplinary surgery, imaging, immunohistochemistry, and careful clinicopathologic correlation.^{9,10} These examples highlight a central lesson: AI and precision oncology depend on connected systems. Digital tools should strengthen referral networks, pathology capacity, molecular diagnostics, registries, and follow-up rather than become isolated applications that generate predictions without a pathway to confirmation or treatment.

An actionable national roadmap should prioritize multicenter Indonesian datasets with standardized definitions, representative sampling, secure governance, and linkage to clinically meaningful outcomes. Molecular testing should be expanded through tiered algorithms that use affordable immunohistochemistry appropriately and reserve broader sequencing for cases in which the results may alter management. AI tools should undergo local calibration, prospective evaluation, health-economic assessment, and continuous monitoring before scale-up. Training in data literacy, molecular pathology, genetic counseling, ethical governance, and multidisciplinary interpretation should become part of obstetrics and gynecology education. The goal is not to adopt the most sophisticated algorithm, but to create a learning health system in which technology helps clinicians deliver earlier, more accurate, more individualized, and more equitable cancer care.^{7,8}

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