BiQancer: A Novel Quantitative Mathematical Biomarker and Automated End-to-End System for Decentralized Cervical Pre-Cancer Detection

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The lack of rapid, accessible, and precise quantitative biomarkers for lesion grading remains the primary barrier to preventing cervical cancer—a leading cause of cancer death among women worldwide, despite being ~100% preventable if detected at the precancerous stage. Without such biomarkers, current Pap smear screening relies heavily on a shortage of pathologists across 160+ countries and suffers from high diagnostic disagreement (=54%). This creates bottlenecks, delaying treatment and increasing the risk of progression to cancer. To address this, we developed BiQancer. In Phase-1, PreCervAI integrates the Cyto-Quantitative Marker (CQ-Marker)—a novel quantitative ruler for traceable cervical lesion grading. It maps 4 key cellular features into a standardized lesion-grade scale. A specialized algorithm is used as a measurement tool to extract micron-level cellular primitives (nucleus, cytoplasm, koilocyte), ensuring all downstream CQ-Marker computations remain traceable to physical morphology, trained on 61,720 images. PreCervAI achieved 97.54%/95.66% Sn; 99.51%/99.13% Sp (controlled/blind), outperforming ResNet50 by 10%. In phase-2, to operationalize PreCervAI in primary care via standard microscopes, we engineered SigmaEyepiece, a $196 hardware add-on that automates standard microscope scanning and image capture. It meets FDA WSI and ISO 19264 at 99.98% lower cost than WSI benchmarks while operating 7.21× faster. Field validation on 240 cases across 5 countries yielded 93.75% Acc, 93.75% Sn, and 98.75% Sp. The system reduced screening time by 72.8% and can increase screening throughput by 80%. BiQancer is an accessible assistive tool for primary care facilities, enabling end-to-end decentralized screening for timely clinical decision-making and early intervention.

Awards Won:
Second Award of $2,400