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# COMPUTER VISION-BASED QUANTITATIVE HORMONE MONITORING FROM LATERAL FLOW ASSAYS IN EARLY PREGNANCY

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## Objective

To develop and validate a computer vision (CV) pipeline for quantitative beta human chorionic gonadotropin ( $\beta$ -hCG) signal extraction from commercial lateral flow assay (LFA) images, and to evaluate brand-specific modeling to improve estimation accuracy.

## Design

Retrospective methodological feasibility study.

## Materials and Methods

De-identified LFA images were analyzed using a two-stage pipeline: region of interest (ROI) segmentation of test and control lines, followed by regression mapping of signal features to serum  $\beta$ -hCG values. A mixed-brand model (397 ROIs, 240 values, 11 brands) served as the baseline; a brand-specific First Response Early Result (FRER) model (225 ROIs, 217 values) was evaluated as the experimental arm. The total dataset comprised 1,519 LFA images and 417 serum values.

## Results

The brand-specific model outperformed the mixed-brand model across all metrics (Table 1). The improvement in regression accuracy indicates inter-brand assay variability is a dominant noise source. Predictions followed expected early pregnancy  $\beta$ -hCG trajectories.

## Conclusions

Automated CV pipeline can extract  $\beta$ -hCG-correlated signal from LFA images without hardware modification. Brand-specific modeling markedly improves accuracy. Future development will target longitudinal hormone monitoring and implantation outcome prediction, enabling accessible at-home early pregnancy surveillance complementing clinical care.

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