

Point-of-care (PoC) diagnostic technologies enable rapid, patient-centric testing and are particularly valuable in resource-limited settings. While paper-based PoC systems are low-cost and portable, their reliance on visual interpretation limits sensitivity and introduces user subjectivity. Smartphones have emerged as powerful analytical platforms for quantitative colorimetric diagnostics; however, variability in illumination and camera parameters poses major challenges for reliable measurement.

In this doctoral thesis, an accessory-free, smartphone-based PoC framework for quantitative colorimetric analysis of urinary biomarkers is developed and validated. Machine learning and deep learning techniques are employed to ensure robustness against lighting variations and inter-device differences. The framework is demonstrated using urine dipsticks and lateral flow assays for albumin and creatinine detection, key biomarkers of kidney disease. The proposed approach offers a scalable, low-cost, and reliable solution for early disease screening in decentralized healthcare settings.