Abstract

An AI-enhanced infrared spectroscopic diagnostic platform that converts a single mid-infrared spectrum of a dried blood spot into binary disease-status outputs across a modular library encompassing infectious, genetic, metabolic, oncologic, autoimmune, toxicological, environmental-exposure and forensic analytes. The platform employs a convolutional autoencoder to compress each spectrum into a 451-element latent feature vector and an ensemble of plug-in machine-learning classifiers to deliver yes/no calls for every target in under 30 seconds—without reagents, cold-chain logistics, or additional blood draw. A rules engine enables real-time quality-control redundancy by cross-checking the HIV classifier output against contemporaneous rapid-test results, automatically flagging discordant cases for confirmatory NAAT. The disposable 3 µL ATR card and handheld spectrometer support low-cost field deployment, while cloud-integrated LIMS, blockchain audit trails, and federated model-update pipelines ensure data integrity, cybersecurity and regulatory compliance. Kit, system and method embodiments collectively enable comprehensive point-of-care screening, newborn testing, epidemiological surveillance, and forensic analysis from a single dried blood spot.