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Sample-to-answer palm-sized nucleic acid testing device towards low-cost malaria mass screening

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Abstract

The effectiveness of malaria screening and treatment highly depends on the low-cost access to the highly sensitive and specific malaria test. We report a real-time fluorescence nucleic acid testing device for malaria field detection with automated and scalable sample preparation capability. The device consists a compact analyzer and a disposable microfluidic reagent compact disc. The parasite DNA sample preparation and subsequent real-time LAMP detection were seamlessly integrated on a single microfluidic compact disc, driven by energy efficient non-centrifuge based magnetic field interactions. Each disc contains four parallel testing units which could be configured either as four identical tests or as four species-specific tests. When configured as species-specific tests, it could identify two of the most life-threatening malaria species (*P. falciparum* and *P. vivax*). The NAT device is capable of processing four samples simultaneously within 50 min turnaround time. It achieves a detection limit of ~0.5 parasites/ μ l for whole blood, sufficient for detecting asymptomatic parasite carriers. The combination of the sensitivity, specificity, cost, and scalable sample preparation suggests the real-time fluorescence LAMP device could be particularly useful for malaria screening in the field settings.

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