A magneto-DNA nanoparticle system for the rapid and sensitive diagnosis of enteric fever

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We present a novel assay designed to detect amplified Salmonella nucleic acid (mRNA) using magneto-DNA probes and a miniaturized nuclear magnetic resonance device. We designed primers for genes specific to S. Typhi, S. Paratyphi A, and genes conserved among Salmonella enterica spp. and utilized strongly magnetized nanoparticles to enhance the detection signal. Blood samples spiked with in vitro grown S. Typhi, S. Paratyphi A, S. Typhimurium, and E. coli were used to confirm the specificity of each probe set, and serial 10-fold dilutions were used to determine the limit of the detection of the assay, 0.01-1.0 CFU/ml. For proof of principle, we applied our assay to 0.5 mL blood samples from 5 patients with culture-confirmed enteric fever from Bangladesh in comparison to 3 healthy controls. We were able to detect amplified target cDNA in all 5 cases of enteric fever; no detectable signal was seen in the healthy controls. Our results suggest that a magneto-DNA nanoparticle system, with an assay time from blood collection of 3.5 hours, may be a promising platform for the rapid and culture-free diagnosis of enteric fever and non-typhoidal Salmonella bacteremia.