Novel molecular detection of drug resistance markers in *Plasmodium falciparum* from Papua New Guinean children with uncomplicated malaria

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**Background:** Parasite drug resistance is a major obstacle to effective malaria control.

**Methods:** To investigate underlying molecular mechanisms, we used a post-PCR, multiplexed ligase detection reaction-fluorescent microsphere assay (LDR-FMA) to detect single nucleotide polymorphisms (SNPs) in *Plasmodium falciparum* drug resistance genes in 402 field isolates from children with falciparum malaria. This technique enables simultaneous identification of 18 SNPs in *pfcrt*, *pfdhfr*, *pfdhps* and 10 allelic variants in *pfmdr1*. We also assessed associations between drug resistance genotypes and in vivo treatment failure rates (PCR-corrected at Day 42) for CQSP, artesunate-SP, piperaquine-dihydroartemisinin and artemether-lumefantrine.

**Results:** There was a high prevalence of multiple mutations across these genes. Eighty-eight percent of the isolates with complete haplotypes were characterised by the quintuple mutation SVMNT + NRNI + KAA + YYSND in the codons 72-76 for *pfcrt*, 51, 59, 108, 164 for *pfdhfr*, 540, 581, 613 for *pfdhps*, and 86, 184, 1034, 1042, 1246 for *pfmdr1*. The presence of the *pfmdr1* 1246Y mutation was associated with treatment failure in all groups combined and in the piperinisedihydroartemisinin group (Fisher’s exact test, \( P = 0.006 \) and 0.004, respectively). Four isolates also carried the 540E *pfdhps* allele in addition to the quintuple mutation. Of other minor haplotypes, NFSDD was found in four isolates but has been associated with artemether-lumefantrine treatment failure in Africa.

**Conclusion:** We found fixation of *pfcrt* 76T, *pfdhfr* 59R and 108N and *pfmdr1* mutations (at 92%, 93%, 95% and 91%, respectively), consistent with previous PNG studies. LDR-FMA is cost-effective, enables high-throughput suitable for large-scale epidemiological studies and extends current PCR-based methods. Our findings are consistent with the previous widespread use of 4-aminoquinolines and SP in PNG and support a change to alternative first-line treatment for uncomplicated falciparum malaria. Since introduction of artemether-lumefantrine treatment in PNG is imminent, monitoring changes in the *pfmdr1* gene and the NFSDD haplotype appears a high priority.

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Identification of intestinal parasites from naturally contaminated hands of people living in low socio-economic areas of Dhaka, Bangladesh

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**Background:** Intestinal parasitic infections are a global problem with more than an estimated one billion infected persons mostly in underdeveloped countries. Children are most effected by these infections. This is predominantly due to poor hygienic conditions, low parenteral health education, and absence of safe drinking water. The scientific evidence describing intestinal parasite and bacterial contamination on paper currency from a developing country highlight the role of poor hand hygiene practices promoting dissemination of infectious diseases including intestinal parasitic egg / (oo)cysts. As a part of parasitological survey to assess the intestinal parasites amongst low socio-economic communities of Indian sub-continent stool and hands were analyzed for evidence of parasite eggs / (oo)cysts from children living in slums of Dhaka, Bangladesh.

**Methods:** A total of 215 stool samples have been analyzed for intestinal parasitic eggs / (oo)cysts using conventional microscopic assay.

**Results:** The general prevalence in this part of the survey of intestinal parasitic egg / (oo)cysts were 37% (79 positive out of 215 stool samples). Of these 79 stool-positive children, to date hands of 65 were sampled in order to screen for any intestinal parasitic egg / (oo)cyst. Three different types of parasitic egg / cysts were recovered from hands of these children. Amongst the helminths, Ascaris 11%, and Trichuris 1.5% were recovered where as the protozoan parasite, Giardia recovery was 5% of hand samples. Over all, 1117% of the children examined carried intestinal parasitic egg / cysts on their hands and 37% in their stool samples, indicating the perpetuation of fecal-hand-mouth cycle of helminths and protozoan infections in these children. To our knowledge this the first report where intestinal parasites have been recovered from naturally-contaminated hand samples of children.

**Conclusion:** Our study highlights the need to include proper hand hygiene practices (washing hands with soap and water) including health hygiene educational promotion programs in order to sustain any chemotherapeutic programs. The data being generated in this survey will be presented and its implications on public health will be discussed.

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