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Evaluating the practical identifiability of a malaria model to assess conversion to transmissible stages

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Plasmodium falciparum is the predominant malaria species that affects humans. This parasite proliferates in the blood stream through asexual reproduction. In each replication cycle, a proportion of these asexual parasites commit to produce gametocytes, the transmissible form, which can be ingested by a mosquito and transferred to another human host. This proportion – "the conversion rate" – is critical to understanding transmission and therefore control of malaria. In 2001, Eichner et al. developed a deterministic model describing the asexual and gametocyte populations of *P. falciparum.* By fitting this model to data on over 100 individual patient infections, Eichner et al. determined a range of possible gametocyte conversion rates. In particular, the average conversion rate has been used extensively in modeling studies over the past two decades. Here, we examine the practical identifiability of this model in order to assess the potential range of gametocyte as we consider the variability of the conversion rates and longevity. Focusing on a well-documented patient, we fit the parameters including the gametocyte conversion rate and produce a simulated gametocyte trajectory. Adding varying degrees of noise to this simulated trajectory and fitting to attempt to recover our parameters, we found that none of the model parameters are practically identifiable. Thus, conclusions on gametocyte conversion and longevity should be reassessed predicting transmission and effectiveness of interventions.