Background and objectives:
Circadian rhythms contribute to treatment efficacy in several non-communicable diseases. However, chronotherapy (administering drugs at a particular time of day) against infectious diseases has been overlooked. Yet, the daily rhythms of both hosts and disease-causing agents can impact the efficacy of drug treatment. We use the rodent malaria parasite *Plasmodium chabaudi,* to test if the daily rhythms of hosts, parasites, and their interactions, affect sensitivity to the key antimalarial, artemisinin.

Methodology:
Asexual malaria parasites develop rhythmically in the host's blood, in a manner timed to coordinate with host daily rhythms. Our experiments coupled or decoupled the timing of parasite and host rhythms, and we administered artemisinin at different times of day to coincide with when parasites were either at an early (ring) or later (trophozoite) developmental stage. We quantified the impacts of parasite developmental stage, and alignment of parasite and host rhythms, on drug sensitivity.

Results:
We find that rings were less sensitive to artemisinin than trophozoites, and this difference was exacerbated when parasite and host rhythms were misaligned, with little direct contribution of host time of day on its own. Furthermore, the blood concentration of haem at the point of treatment correlated positively with artemisinin efficacy but only when parasite and host rhythms were aligned.

Conclusions and implications:
Parasite rhythms influence drug sensitivity *in vivo*. The hitherto unknown modulation by alignment between parasite and host daily rhythms suggests that disrupting the timing of parasite development could be a novel chronotherapeutic approach.