MMED

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Table 1: Parameters

Parameter	Definition	Value	Source
b	Births ($Number \times day^{-1}$)	37,4	data.worldbank.org and Ethiopia Census 2007
μ	Death rate (day^{-1})	$7,0 \times 10^{-5}$	data.worldbank.org
θ	Ageing out (day^{-1})	$1/10\times365$	*Derived*
λ	Force of infection (day^{-1})	–	*Derived*
β	Rate of transmission (day^{-1})	0,076	Gambhir et al. 2009
σ	Relative susceptibility of diseased	0,5	Pinsent and Hollingsworth 2018
α	Rate of progression to symptomatic (day^{-1})	$1/14$	Grassly et al. 2008
γ_1	Recovery rate from infectiousness, first infection (day^{-1})	0,005	Pinsent and Hollingsworth 2018
ω_1	Recovery rate from disease, first infection (day^{-1})	0,0033	Pinsent and Hollingsworth 2018
γ_i	Recovery rate from infectiousness, repeat infection (day^{-1})	0,0955	Pinsent and Hollingsworth 2018
ω_i	Recovery rate from disease, repeat infection (day^{-1})	0,0126	Pinsent and Hollingsworth 2018
N_0	Initial population	118 411	Ethiopia Census 2007 and WPP 2022

$$\lambda = \frac{\beta(I_{P1} + I_{T1} + I_{Pi} + I_{Ti})}{N}$$

$$\frac{dS_1}{dt} = b - S_1(\lambda + \mu + \theta)$$

$$\frac{dI_{P1}}{dt} = \lambda S_1 - I_{P1}(\alpha + \mu + \theta)$$

$$\frac{dI_{T1}}{dt} = \alpha I_{P1} - I_{T1}(\gamma_1 + \mu + \theta)$$

$$\frac{dD_1}{dt} = \gamma_1 I_{T1} - D_1(\omega_1 + \lambda\sigma + \mu + \theta)$$

$$\frac{dS_i}{dt} = \omega_1 D_1 + \omega_i D_i - S_i(\lambda + \mu + \theta)$$

$$\frac{dI_{Pi}}{dt} = \lambda S_i - I_{Pi}(\alpha + \mu + \theta)$$

$$\frac{dI_{Ti}}{dt} = \alpha I_{Pi} + \lambda\sigma(D_1 + D_i) - I_{Ti}(\gamma_i + \mu + \theta)$$

$$\frac{dD_i}{dt} = \gamma_i I_{Ti} - D_i(\omega_i + \lambda\sigma + \mu + \theta)$$