Basic Reproduction Number dari Model Penyebaran Penyakit Filariasis

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ITB,6 Januari 2007

Apa itu Penyakit Kaki Gajah?

Filariasis (penyakit kaki gajah) adalah penyakit menular menahun yang disebabkan oleh cacing *filaria*.

Penyakit ini ditularkan oleh berbagai jenis nyamuk

Asumsi

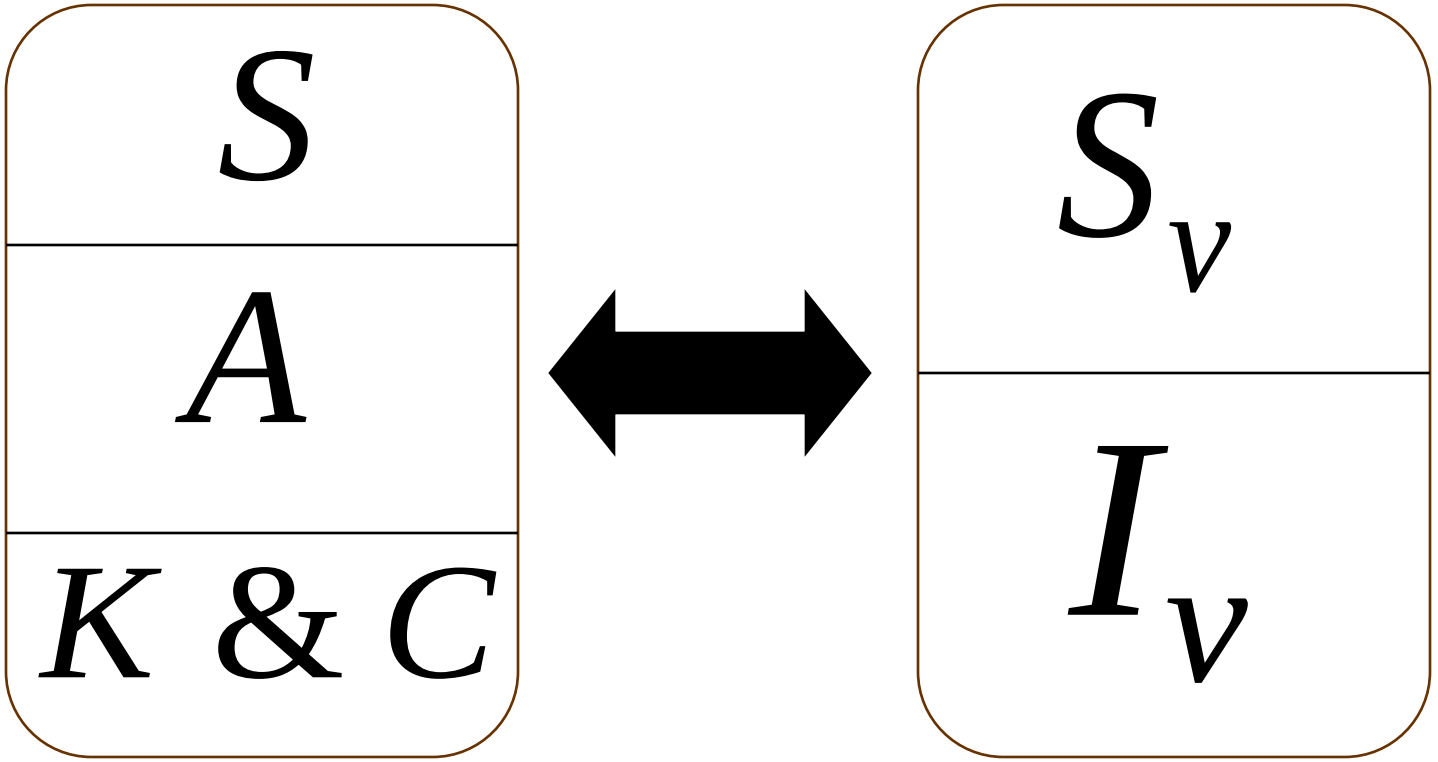
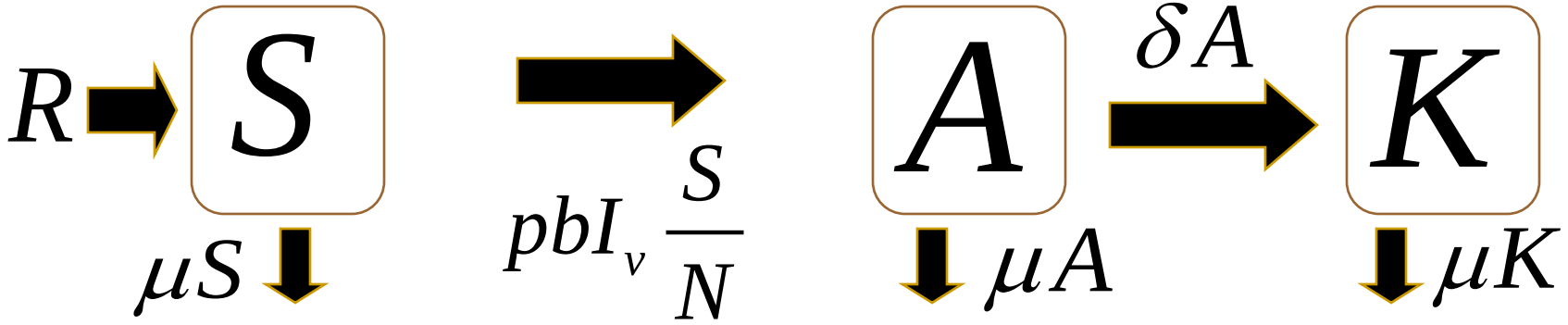
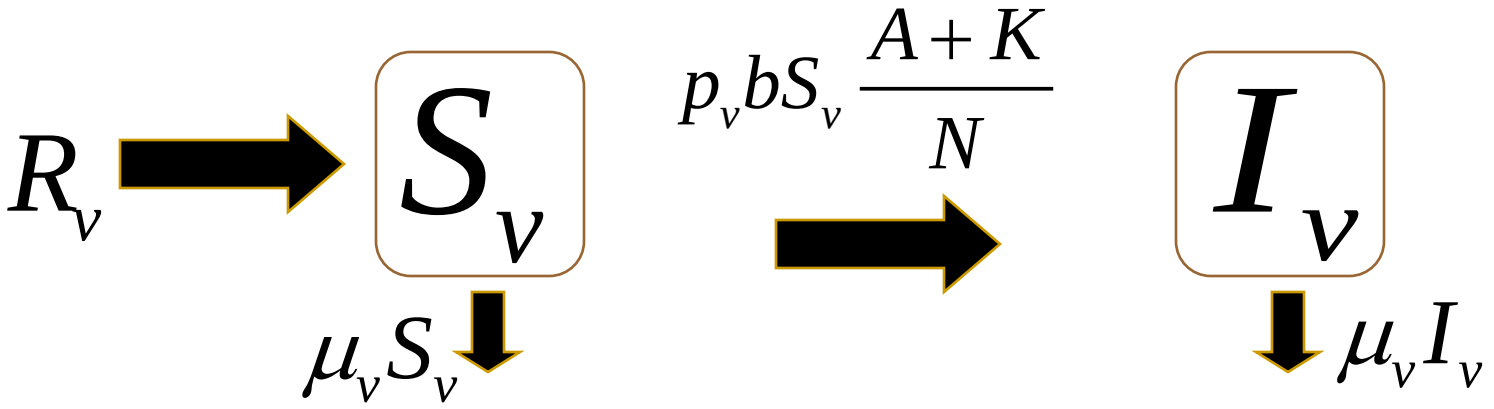


Diagram Skematik Tanpa Pengobatan





Model Penyebaran Filariasis tanpa Pengobatan

$$\frac{dS}{dt} = R - pbI_v \frac{S}{N} - \mu S$$

$$\frac{dA}{dt} = pbI_v \frac{S}{N} - \delta A - \mu A$$

$$\frac{dK}{dt} = \delta A - \mu K$$

$$\frac{dS_v}{dt} = R - p_v b S_v \frac{(A+K)}{N} - \mu_v S_v$$

$$\frac{dI_v}{dt} = p_v b S_v \frac{(A+K)}{N} - \mu_v I_v$$

Titik Kesetimbangan

$$T1: I_v = 0,\ K = 0,\ A = 0$$

$$T2: I_v = \frac{-\mu_v{}^2 R + p_v b^2 R_v p}{b\left(p_v b + \mu_v\right)\mu_v p}$$

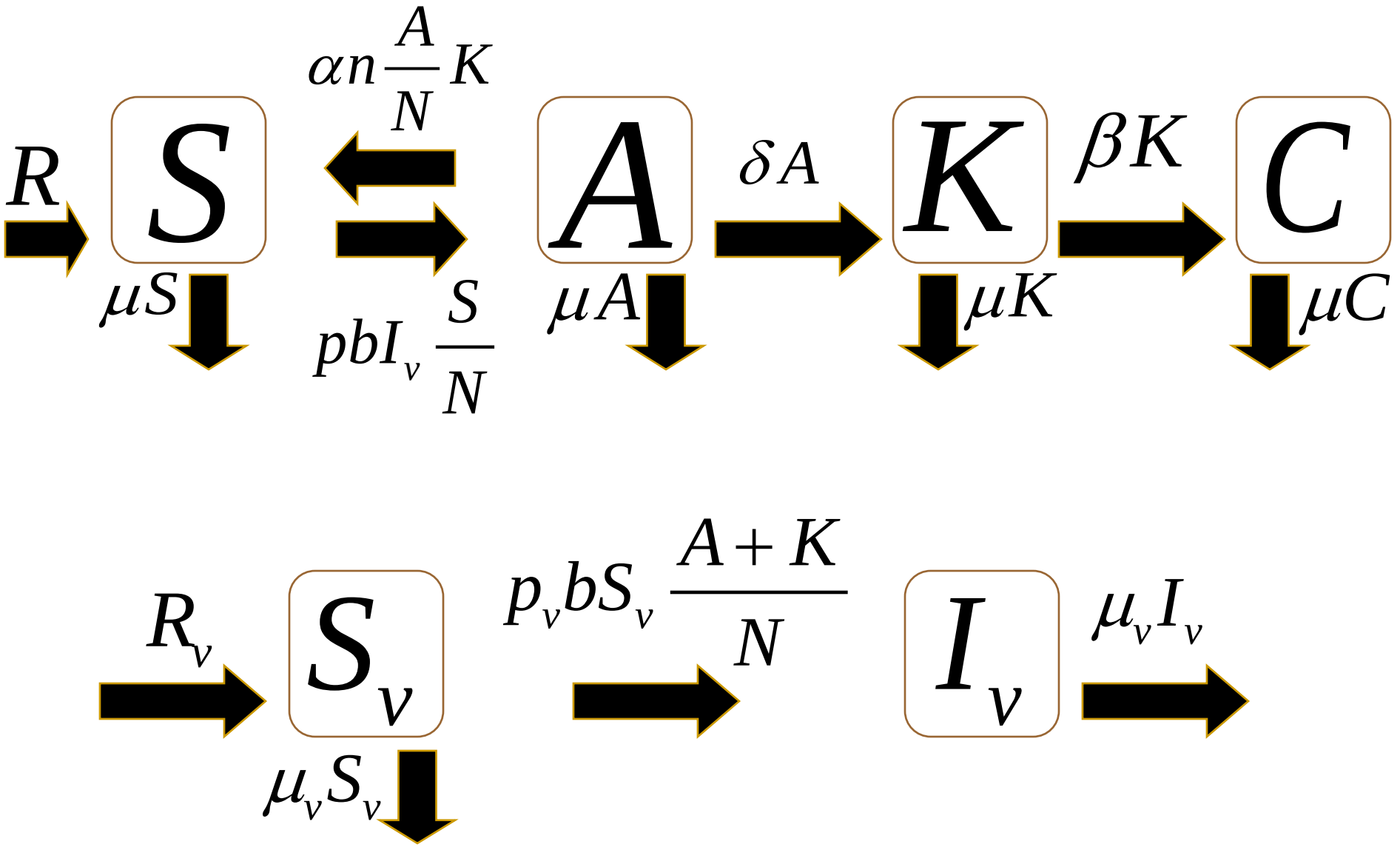
$$K = \frac{\delta R\left(-\mu_v{}^2 R + p_v b^2 R_v p\right)}{p_v b\left(\mu_v p\delta + bR_v \delta p + \mu_v R\mu + b\mu R_v p\right)\mu}$$

$$A = \frac{R\left(-\mu_v{}^2 R + p_v b^2 R_v p\right)}{p_v b\left(\mu_v R\delta + bR_v \delta p + \mu_v R\mu + b\mu R_v p\right)}$$

Basic Reproduction Number

$$Ro = \frac{R_v b^2 p_v p}{Rm_v{}^2}$$

Diagram Skematik dengan Pengobatan



Model Penyebaran Filariasis dengan Pengobatan

$$\frac{dS}{dt} = R + \alpha n \frac{A}{N} K - pbI_v \frac{S}{N} - \mu S$$

$$\frac{dA}{dt} = pbI_v \frac{S}{N} - \delta A - \alpha n \frac{A}{N} K - \mu A$$

$$\frac{dK}{dt} = \delta A + pbI_v \frac{C}{N} - \beta K - \mu K$$

$$\frac{dC}{dt} = \beta K - pbI_v \frac{C}{N} - \mu C$$

$$\frac{dS_v}{dt} = R_v - p_v bS_v \frac{(A+K)}{N} - \mu_v S_v$$

$$\frac{dI_v}{dt} = p_v bS_v \frac{(A+K)}{N} - \mu_v I_v$$

$$Ro = \frac{R_v b^2 p p_v \mu (\beta + \mu + \delta)}{R \mu_v^{\,2} (\beta + \mu)(\mu + \delta)} > 1$$

Next Generation Matrix, tidak bergantung pada parameter n.
Subsitusi n=0 pada model penyebaran filariasis dengan pengobatan.
akibatnya diperoleh titik kritis yang lebih sederhana.

$$I_v = \frac{x}{bz\mu_v p_h} \qquad A = \frac{-xR_h}{yp_v b\mu_h}$$

$$C = \frac{\beta\delta R_h x}{p_v b\mu_h^{\,2}\omega} \qquad K = \frac{-\delta R_h x}{p_v b\mu_h \omega}$$

$$w = \mu_v R_h \beta^2 \delta + 3\mu_v R_h \delta \mu_h \beta + \mu_v R_h \mu_h \beta^2 + 2\mu_v R_h \mu_h{}^2 \beta + 2\mu_v R_h \delta \mu_h{}^2 + \mu_v R_h \mu_h{}^3 + \mu_v R_h \delta^2 \beta + \mu_v R_h \delta^2 \mu_h + b\mu_h R_v \beta^2 p_h + 2b\mu_h{}^2 R_v \beta p_h + 3b\mu_h R_v \beta p_h \delta + bR_v \beta^2 p_h \delta + b\mu_h{}^3 R_v p_h + 2b\mu_h{}^2 R_v p_h \delta + b\mu_h R_v \delta^2 p_h + bR_v \delta^2 p_h \beta$$

$$x = -\mu_v{}^2 R_h \mu_h{}^2 - \mu_v{}^2 R_h \delta \mu_h - \mu_v{}^2 R_h \delta \beta - \mu_v{}^2 R_h \mu_h \beta + p_v b^2 \mu_h R_v \beta p_h + p_v b^2 \mu_h{}^2 R_v p_h + p_v b^2 \mu_h R_v \delta p_h$$

$$y = \beta \mu_v R_h \delta + \beta \delta b R_v p_h + \mu_v R_h \mu_h \beta + b\mu_h R_v \beta p_h + \mu_v R_h \delta^2 + 2\mu_v R_h \delta \mu_h + R_v \delta^2 p_h + b\mu_h{}^2 R_v p_h + 2b\mu_h R_v p_h \delta + \mu_v R_h \mu_h{}^2$$

$$z = \delta \beta \mu_v + \delta p_v b \mu_h + \delta \mu_v \mu_h + p_v b \mu_h \beta + \mu_v \mu_h \beta + p_v b \mu_h{}^2 + \mu_v \mu_h{}^2$$