Mapping the Risk of International Infectious Disease Spread (MRIIDS):

Milestone 6: A model to predict the spread of infectious disease threats

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1 Incidence prediction

$$I_{j,t} \sim Pois\left(\sum_{i=1}^{n}\left(p_{i\to j} R_t^i \sum_{s=1}^{t}\left(I_{i,t-s}\omega_s\right)\right)\right)$$

Thus the number of incidences at time t at location j is distributed according to a Poisson distribution with the mean given by the matrix product:

$$\lambda_{j,t} = \begin{pmatrix} p_{1j} & p_{2j} \dots p_{nj} \end{pmatrix} \times \begin{pmatrix} R_t^1 I_{t-1}^1 & R_t^1 I_{t-2}^1 & \dots & R_t^1 I_0^1 \\ \dots & & & \\ R_t^n I_{t-1}^n & R_t^n I_{t-2}^n & \dots & R_t^n I_0^n \end{pmatrix} \times \begin{pmatrix} \omega_1 \\ \dots \\ \omega_t \end{pmatrix},$$

where R_t^i is the instantenous reproduction number at time t at location i and I_t^i is the incidence at time t at location i.