

MCMC for Influenza Burden Estimation from Hospitalization Surveillance data

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Data

1. N : Total FluSurv-NET (FSN) population (given stratum, e.g. age group, state, etc.)
2. M : Total US population
3. n_H : Number of observed influenza hospitalizations with non-lethal outcome
4. n_D : Observed influenza deaths
5. t_{kj} : Numbers tested by outcome and test type (1: PCR, 2: Rapid, 3: Other, 4: No test)
6. ρ_k : Prior dist. for test sensitivities (PCR, rapid; mean, SD)

Parameters to be sampled, fully conditional likelihoods L

m_H : True number of influenza hospitalizations (non-lethal) in FSN population, unobserved

$$L(m_H | \dots) \propto \frac{e^{-\lambda_H N} (\lambda_H N)^{m_H}}{m_H!} \times \binom{m_H}{n_H} \tau_0^{n_H} (1 - \tau_0)^{(m_H - n_H)}, \quad (1)$$

where the “detection probability” in those with non-lethal outcomes is $t_0 = \phi_0 \sum_j \pi_{0j} \sigma_{0j}$; definitions of ϕ_0 , π_{0j} , and σ_{0j} as given below.

λ_H : Influenza hospitalization rate, non-lethal outcome

$$L(\lambda_H | \dots) \propto \frac{e^{-\lambda_H N} (\lambda_H N)^{m_H}}{m_H!} \times \quad (2)$$

λ_D : Influenza hospitalization rate, lethal outcome

$$L(\lambda_D | \dots) \propto \frac{e^{-\lambda_D \epsilon N} (\lambda_D \epsilon N)^{m_D}}{m_D!}, \quad (3)$$

m_D : total number of influenza deaths deaths in FSN population

$$L(m_D | \dots) \propto \frac{e^{-\lambda_D \epsilon N} (\lambda_D \epsilon N)^{m_D}}{m_D!} \times \binom{m_D}{n_D} \tau_1^{n_D} (1 - \tau_1)^{(m_D - n_D)}, \quad (4)$$

ϵ : Outside-hospital death proportion

$$L(m_D|\dots) \propto \frac{e^{-\lambda_D} \epsilon^N (\lambda_D \epsilon N)^{m_D}}{m_D!} \quad (5)$$

ϕ_0 : True influenza-positivity rate, in non lethal outcomes)

$$L(\phi_0|\dots) \propto \binom{m_H}{n_H} \left(\phi_0 \sum_j \pi_{0j} \sigma_{0j} \right)^{n_H} (1 - \phi_0 \sum_j \pi_{0j} \sigma_{0j})^{m_H - n_H} \times \begin{pmatrix} above \\ below \end{pmatrix} \quad (6)$$

π_{0j} : Testing probabilities in non-lethal outcomes, by test type

$$L(\pi_{0j}|\dots) \propto \frac{e^{-\lambda_H} N (\lambda_H N)^{m_H}}{m_H!} \times \binom{m_H}{n_H} \tau_0^{n_H} (1 - \tau_0)^{(m_H - n_H)}, \quad (7)$$

g_{kj}

Unobserved number of influenza positives, by outcome k and test type j

σ_{kj}

Test sensitivity, by outcome k and test type j