Propagated vaccine immunity is stronger if derived from natural infection.

1. Motivation & aims

Seasonal influenza-related respiratory illnesses cause an estimated annual death toll of 291,000-646,000 people [1]. Influenza vaccination can offer some protection against infection for the individual, while contributing to reduced risk of ongoing transmission via establishment of herd immunity [2]. Transmission models connected to data, when interfaced with health economic evaluations, are a key tool to inform national influenza vaccine policy [3]. However, prior modelling studies have typically treated

\[ \alpha \min(\beta) \min(c) \]

Propagated vaccine immunity related linearly to prior season vaccine efficacy: 

\[ \alpha \min(\beta) \min(c) \]

1. Motivation & aims

2. Model overview

- Non-age, multi-strain model, capturing the four strains targeted by the quadrivalent influenza vaccine: A(H1N1)pdm09, A(H3N2), B/Victoria, B/Yamagata.

Fig. 1: Model schematic. Process A (circled capitalised letters), propagation of immunity; process B, modulation of current influenza season virus susceptibility; process C, estimation of influenza case load; process D, ascertainment of cases.

3. Immunity propagation model component

Fig. 2: Interaction between prior season exposure and start of season susceptibility. Strain susceptibility

\[ \alpha \min(\beta) \min(c) \]

- Propagated vaccine immunity related linearly to prior season vaccine efficacy:

\[ \alpha \min(\beta) \min(c) \]

4. Transmission & observation model components

- Vaccination model: ‘Leaky’ vaccine
- Epidemiological model: SEIR-type deterministic, ODEs (Fig. 3).

\[ Z_m(y) = \left( \int \gamma_m(E_m^c + E_m^r) \, dt \right) \times 100,000. \]

Fig. 3: Transmission model schematic (for a single strain).

5. Results: Parameter inference

• Invoked an adaptive-population Monte Carlo algorithm [4]. Prior season influenza B cross-reactivity and carry over vaccine efficacy had little impact on immunity.

6. Results: Goodness-of-fit

• Augment model with age structure.
- Couple transmission model with economic evaluation frameworks.
- Appraise cost-effectiveness of prospective seasonal influenza vaccine programmes.

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References