Pseudo-code for LTBI screening model

Nathan Green

2019-01-22

Introduction

Describes a type of microsimulation and cost-effectiveness analysis using a synthetic cohort of recent immigrants to the UK. Much of the work is in setting up the cohort.

Pre-simulation setup

- Load in ETS/pre-screening dataset, denote by X
- Define simulation constants
  - Number of Monte-Carlo iterations, N
  - Age range for screening
  - Year cohort
  - Screen delay range, 5 years
  - Time horizon (default life-time 100 years)
- Define cost-effectiveness distributions
  - Willingness to pay
  - Secondary infections
  - Costs
  - QALY
  - Test performance
  - Effectiveness
  - Current year
- Create `policy`
- Define which subsets of cohort to target for screening
  - WHO incidence
  - All QALY?
  - All costs?
  - Treatment regimen
  - LTBI test
- Define `scenario`
  - Screening pathway probability distributions
  - Cost distributions
- Sample screening year $unif[0, 5]$ for X
- Remove individuals from X according to
  - Simulation constants
  - Screening year
- Join probability LTBI by incidence in country of origin and year
  - Sample realisations
- Calculate time to events from dates
- Create probability incidence curve
  - Append Sutherland and Lancet
- Generate TB progression times for LTBI individuals, consistent with other dates
- Join CFR for given age
  - Sample case fatality realisations, I_{cf}
- Calculate QALYs for TB cases from progression date to death for
  - Disease-free

- Cured
- Case fatality
- Status-quo i.e. either fatality or cured depending on I_{cf}

- Calculate future discounts at
  - Time of notification
  - Time of secondary infection (i.e. 1 year afterwards)
- Define decision tree object structures, denote d_{health} and d_{cost}

Simulation

- Set policy $i = 1$
- Remove individuals from X according to $f(X, i) = X'$
- Calculate mean screening delay from entry to screening and associated discount
- Calculate proportion in each incidence group from X'
- Get treatment regimen from policy, $t = treatment(i)$
  - Get cost of treatment, $cost(t)$
  - Get effectiveness of treatment, $eff(t)$
- Substitute cost and probabilities in to d
  - Incidence groups
  - LTBI status
  - $eff(t)$
  - $cost(t)$
  - ~~GP incentives~~

Screening model

- Set scenario $j = 1$
- Assign branch value for j to d_{health} and d_{cost}
- For d_{health} and d_{cost} and each iteration $n = 1, \ldots, N$
- Sample
  - Branch probabilities
  - Costs
  - Utilities/QALYs
- Calculate
  - Total expected values for cost c_1^s and QALYs q_1^s
  - Subpopulation probabilities, P, including LTBI to cured

TB model

- Set scenario $j = 1$
- For each iteration $n = 1, \ldots, N$
- Sample TB treatment cost
- Calculate status-quo, with discounting
  - Cost, c_0^{tb}
  - QALYs, q_0^{tb}
- Get $p = P(\text{LTBI to cured})[n]$
- Replace first p proportion of TB cases with disease-free individuals
- Calculate screened outputs, with discounting
  - Cost, c_1^{tb}
  - QALYs, q_1^{tb}
- Sum screening and TB costs and QALYs
  - $c_1^s + c_1^{tb}$
  - $q_1^s + q_1^{tb}$