FAQ: STHLM3

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eScience for Cancer Prevention and Control Flagship

1. Prostate cancer

- What is the prostate?
- Does the prostate have any 'design issues'?
- What is the health burden due to prostate cancer?
- Are there effective preventive interventions for prostate cancer?

2. PSA testing

- What is the prostate-specific antigen (PSA) test?
- How common is the PSA test in Sweden?
- What are the benefits due to PSA screening for prostate cancer?
- What are the harms due to PSA screening for prostate cancer?
- Is the PSA test an effective screening test for prostate cancer?

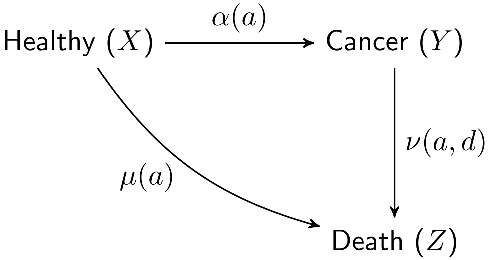
3. STHLM3

- What is the STHLM3 study and the STHLM3 Model (S3M)?
- How has SeRC contributed to the STHLM3 study?
- Which machine learning algorithm was used for the S3M?
- What were the main findings of the STHLM3 study?
- How can we assess the cost-effectiveness of S3M?

4. Microsimulation

- What is a microsimulation?

State diagram for an illness-death model



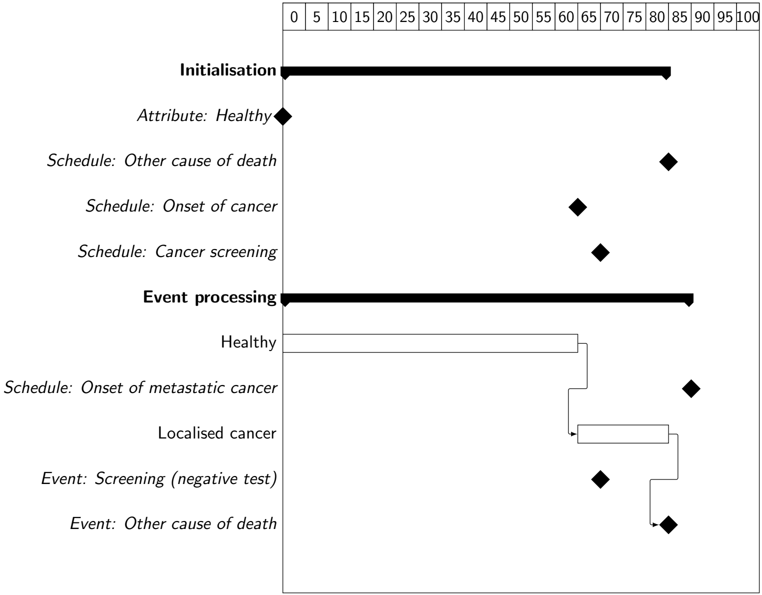
where $X(0) = 1$ and $Y(0, d) = 0$. Life expectancy can then be calculated by:

$$\begin{aligned}
\mathrm{LE} &= \int_0^\infty X(a)\mathrm{d}a + \int_0^\infty \int_a^\infty Y(a, v-a)\mathrm{d}v\mathrm{d}a \\
&= \int_0^\infty \exp\left(-\int_0^a \alpha(u) + \mu(u)\mathrm{d}u\right)\mathrm{d}a + \\
&\quad \int_0^\infty \int_a^\infty \exp\left(-\int_0^a \alpha(u) + \mu(u)\mathrm{d}u\right)\alpha(a)\exp\left(-\int_a^v \nu(u, u-a)\mathrm{d}u\right)\mathrm{d}v\mathrm{d}a
\end{aligned}$$

Illness-death model as a discrete event simulation (Python 3)

```
import queue; import random
rexp = random.expovariate
def lifetime():
    (time, running) = (0, True)
    events = queue.PriorityQueue()
    events.put( (rexp(1.0/70), "Death" ) )
    events.put( (rexp(1.0/60), "Cancer") )
    while (running and not events.empty()):
        (time, type) = events.get()
        if type == "Death":
            running = False
        if type == "Cancer": # excess mortality
            events.put( (time+rexp(1.0/20.0),
                         "Death") )
    return time # age at death
```

Microsimulation using pictures



Cost-effectiveness

For intervention k, we can calculate the expected effectiveness and costs:

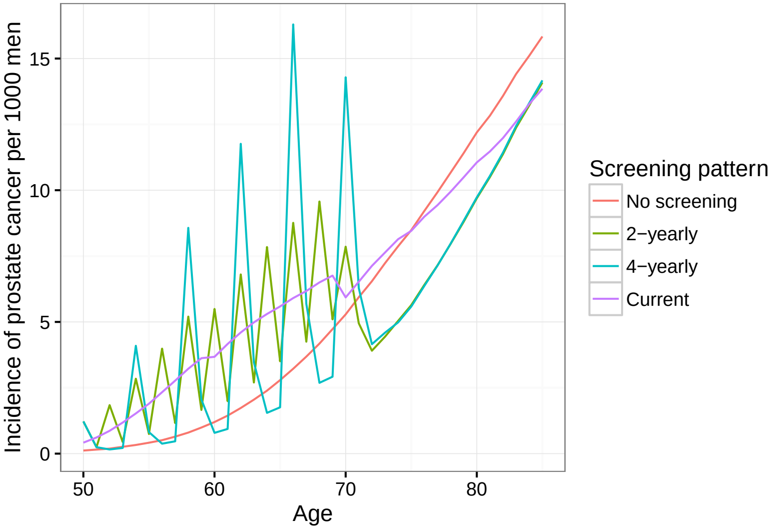
$$\begin{aligned}
\text{Effectiveness}_k =& \frac{1}{n}\sum_{i=1}^{n}\int_0^\infty \frac{dU_{ik}(t)}{(1+\delta)^t} \\
\text{Costs}_k =& \frac{1}{n}\sum_{i=1}^{n}\int_0^\infty \frac{dC_{ik}(t)}{(1+\delta)^t}
\end{aligned}$$

where we simulate for n individuals with index i, with individual-based cumulative utilities $U_{ik}(t)$ and costs $C_{ik}(t)$ at time t, with discounting δ (e.g. $\delta = 0.03$).

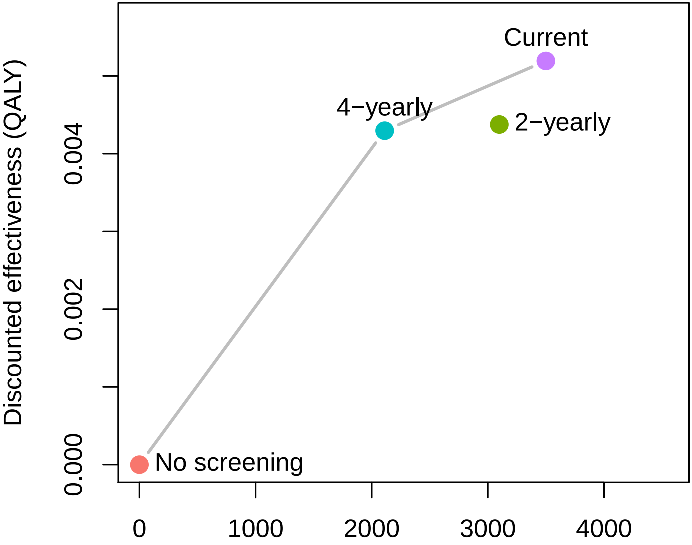
4. Microsimulation

- What is a microsimulation?
- What tools have you developed for microsimulation?

Predicted cancer incidence under different screening scenarios



Cost-effectiveness under different screening scenarios



Conclusions

- eScience has raised the level of evidence used in STHLM3 – and can help with changing prostate cancer screening worldwide

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