European Innovation Partnership on Active and Healthy Ageing

MAFEIP data-workshop

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1. Introduction
2. Resource use
3. Health related Quality of Life
4. Transition probabilities
We aim for an interactive session with plenty of examples, exercises and discussions, in order to:

- Obtain a better understanding of data availability within commitments
- Discuss with you different ways to use the available data for our purposes
- Identify alternative routes to populate the model if data is missing
- Based on your input, further develop the conceptual framework, and
- Based on this workshop, define an approach to facilitate the roll out of the tool in the future
We hope that you will....

• Find this workshop useful to learn more about the model concept for the EIP on AHA

• Together with us, identify options to adapt our methods to your setting, and

• Perceive the potential benefits of using the planned monitoring tool in your setting
A note of caution

All examples presented during this workshop, including their numerical values, are hypothetical and for illustrative purposes only!

However, we tried to construct examples which are closely related to the context of the EIP on AHA
So let's get started
Short recap from the morning session

**Headline Target**

+2 HLYs

**Triple Win**

- **QALYs**
- **Health, care expenditure**
- **Innovation & Growth**

**Outcome Indicators on intervention / commitment level**

- HRQoL
- Mortality
- Risk factors
- Physical Activity
- Adherence
- Frailty
- Functional status
- Falls
- Nutrition
- Mental health
- Cognitive decline
- Incremental change in resources used
- (Local) unit cost for resources
- Nr. of implemented technologies
- Nr. of users of new technologies
- Nr. of created jobs
- Nr. of new SMEs
In the morning session, we also introduced our model concept, which consists of:

- **Health states** a target patient is currently in and / or may experience in the future
- **Probabilities** to move from one health state to another, and for each health state
- **Costs** (resource use valued in monetary units), and
- **Values or utilities** for health outcomes
Introducing the model

The process in a nutshell

1) Adapt the model by defining appropriate health states

2) Assess data availability for probabilities, costs, and health state values / utilities

3) Identify secondary sources of data if inputs for model parameters are missing

4) Populate and run the model for the base case and the intervention scenario

5) Calculate incremental health gain / incremental health system impact
Introducing the model

A hypothetical example

<table>
<thead>
<tr>
<th></th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>P=0.8</td>
<td>P=0.15</td>
<td>P=0.05</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>P=0</td>
<td>P=0.9</td>
<td>P=0.1</td>
</tr>
<tr>
<td>Dead</td>
<td>P=1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HRQoL</th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HC-cost</th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>€ 5000</td>
<td>0</td>
</tr>
</tbody>
</table>

Task: calculate baseline QALYs and sustainability outcomes for a patient cohort of 1000 healthy individuals over a 5 year period

<table>
<thead>
<tr>
<th>cycle</th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>800</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>640</td>
<td>255</td>
<td>105</td>
</tr>
<tr>
<td>4</td>
<td>512</td>
<td>326</td>
<td>163</td>
</tr>
<tr>
<td>5</td>
<td>410</td>
<td>370</td>
<td>221</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QALYs / Patient</th>
<th>Cost / Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.000</td>
<td>0.00</td>
</tr>
<tr>
<td>0.875</td>
<td>750.00</td>
</tr>
<tr>
<td>0.768</td>
<td>1275.00</td>
</tr>
<tr>
<td>0.675</td>
<td>1627.50</td>
</tr>
<tr>
<td>0.594</td>
<td>1848.75</td>
</tr>
</tbody>
</table>

€ 5501.25
Introducing the model

A hypothetical example

Scenario: now imagine that a preventive intervention that costs on average 300€ per patient and year reduces the risk of acquiring the disease from 0.15 to 0.1

<table>
<thead>
<tr>
<th>HRQoL</th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline health</td>
<td>HRQoL = 1</td>
<td>HC-cost = 300</td>
<td>P = 0.85</td>
</tr>
<tr>
<td>Deteriorated health</td>
<td>HRQoL = 0.5</td>
<td>HC-cost = 5000</td>
<td>P = 0.1</td>
</tr>
<tr>
<td>Healthy</td>
<td>P=0.85</td>
<td>P=0.1</td>
<td>P=0.05</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>P=0</td>
<td>P=0.9</td>
<td>P=0.1</td>
</tr>
<tr>
<td>Dead</td>
<td>P=1</td>
<td></td>
<td></td>
</tr>
</tbody>
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<th>Unhealthy</th>
<th>Dead</th>
</tr>
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<td>1</td>
<td>0.5</td>
<td>0</td>
</tr>
<tr>
<td>Unhealthy</td>
<td>P=0</td>
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<td>P=0.1</td>
</tr>
<tr>
<td>Dead</td>
<td>P=1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>HC-cost</th>
<th>Healthy</th>
<th>Unhealthy</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>€ 300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>€ 5000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

We can now calculate incremental QALYs and impact on health & care expenditure

\[ \Delta E: 4.095 - 3.912 = 0.183 \]
\[ \Delta C: 4977 - 5501 = -504 \]
The appeal of DAM for MAFEIP is its tremendous flexibility as the approach:

"pulls together the many needed pieces of information from multiple sources and then stitches them together into a (hopefully) cohesive whole"

O'Brian (1996) Economic evaluation of Pharmaceuticals – Frankensteins Monster or Vampire of Trials, Medical Care, 34.12
However, there is no 'one size that fits all'!

*We always have to work around the existing data, identify the relevant gaps, and fill them with the best available evidence from secondary data sources!*
1. Introduction

2. Resource use

3. Health related Quality of Life

4. Transition probabilities
Overall approach

1. Identify key resources
   • Which resources are likely to be affected?
   • Which of those resources are likely to influence costs?

2. Assess quantities of resources used
   • What are the quantities of the resources consumed (per patient / on average) for each care alternative?

3. Value resources
   • What are the (local) unit cost of the resources consumed?
Level of precision

For instance:

Hospital day
Hospital day at ward
Hospital day by diagnostic group (DRG / HRG etc.)
Tests, staff time, drugs & consumables, use of capital, equipment + "hotel costs"
Resource use

Costing perspective

Societal
Public sector
Health system
Care system
## Costing perspective

**Question:** which cost would you consider from which perspective?

<table>
<thead>
<tr>
<th>Resource item</th>
<th>Health System</th>
<th>Care System</th>
<th>Public Sector</th>
<th>Society</th>
<th>Private individuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital inpatient episodes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary care visits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stay in nursing home</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel to and from the hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caring by family and friends</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benefit Payments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

Think of the resources affected by the intervention(s) delivered within your commitment

• Which perspective is most suited for your commitment?
Estimating cost in health states

Example: The table below provides (hypothetical) costing information for a multimodal intervention to reduce lower back pain vs. standard care.

Calculate the total cost per patient for both care alternatives for the first model cycle (twelve month)

<table>
<thead>
<tr>
<th>Resource item</th>
<th>Resource use over 12 months</th>
<th>Unit cost</th>
<th></th>
<th>Intervention</th>
<th>Standard care</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intervention (n=100 patients)</td>
<td>Standard care (n=100 patients)</td>
<td>Euro per item</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multimodal treatment cost</td>
<td>100</td>
<td>-</td>
<td>2,000</td>
<td>200,000</td>
<td>--</td>
</tr>
<tr>
<td>medication (DDD's)</td>
<td>20,000</td>
<td>100,000</td>
<td>2</td>
<td>40,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Hospital admissions</td>
<td>10</td>
<td>25</td>
<td>3,500</td>
<td>35,000</td>
<td>87,500</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>30</td>
<td>200</td>
<td>70</td>
<td>2,100</td>
<td>14,000</td>
</tr>
</tbody>
</table>

Per patient cost at t=1: 2,771 3,015

Incremental cost of intervention at t=1: 2,771-3,015 = -244
Discussion

What are the key resources affected by your intervention? (both positively and negatively)

Do you collect information on the quantities of these resources? If so,
  a) per patient
  b) on average for a certain patient cohort

Do you collect information on unit cost? (on which level: local, regional, national)
Any questions on resource use?
Agenda

1. Introduction
2. Resource use
3. Health related Quality of Life
4. Transition probabilities
Valuing health states

For assessing the *quantitative* impact of an intervention on patients' health, we need to:

- **assign weights** to different health states to
- encode the perceived quality of life of an individual in this state
Valuing health states

- Baseline health
- Deteriorated health
- Dead

HRQoL

Baseline health

Deteriorated health

Dead

HRQoL (1≥X>0)

HRQoL (1>X>0)

HRQoL (= 0)
Discussion

- Do you collect HRQoL data?
- If so, which tool(s) are you using?
Valuing health states

There are many different HRQoL-'tools' available (both generic and disease specific), and we found large variety across EIP on AHA commitments.
Valuing health states

Within the context of MAFEIP, there are both theoretical and practical reasons to regard the EQ-5D instrument as a reference:

- The EQ-5D is generic,
- preference based,
- it provides value sets for most European countries,
- it has been translated into, and validated for, many languages and
- it is the most commonly used instrument across EIP on AHA commitments

But what if there is no EQ-5D data available?
Mapping

The scientific literature offers different methods to 'map', or 'crosswalk' from one instrument towards another.

Hence, with the appropriate information, we can convert HRQoL-weights collected with one instrument into equivalent EQ-5D weights.

Depending on the information available from commitments, there are different methods available.
Mapping

‘Mapping’ or ‘cross walking’:

A technique to link outcomes from different tools of HRQoL to a single specific tool as a 'common currency' to facilitate aggregation.
<table>
<thead>
<tr>
<th>Mapping Approach</th>
<th>Description</th>
<th>Information needed</th>
</tr>
</thead>
</table>
| Subjective mapping        | Rely on expert opinion                           | • HRQoL tools used
                           | → Response mapping                         | → Health states (dimension + levels)                                               |
| Empirical aggregate       | Rely on published aggregate health states data    | • Mean HRQoL-scores for subgroups of patients
                           | → Quantitative mapping                     | • Subgroup characteristics clinical characteristics, social-demographic characteristics, etc. |
| individual level mapping  | Rely on published regression models or algorithms | • Health states / HRQoL-scores for individuals / patients
                           | → Response mapping                         | • Patient characteristics clinical characteristics, social-demographic characteristics, etc. |
                           | → Quantitative mapping                         |                                                                                      |
Discussion

If you measure/value health states but not with the EQ-5D, which mapping strategy sounds most feasible given the data you collect?

• Empirical individual level mapping
• Empirical aggregate mapping
• Subjective mapping
Any questions on HRQoL?
Agenda

1. Introduction
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4. Transition probabilities
We generally look into four transition probabilities for our model:

A) the incidence of the specific health condition  
B) the probability of recovery from that condition  
C) the baseline mortality in the target population and  
D) the mortality in the population with deteriorated health

Probabilities are bound between 0 and 1, hence we can calculate respective probabilities to remain in one health state, i.e.:

\[ E = 1 - (A + C) \]
\[ F = 1 - (B + D) \]
**Time constant probabilities**

An easy way to populate the model

**Example 1:** Out of a target cohort of 100 individuals with no prior health condition, 16 experience a CHD-event within a 1 year period.

**Question:** What is the 1 year probability to move from 'healthy' to 'CHD'

**Answer:** \( \frac{16}{100} = 0.16 \)
Time constant probabilities

Hence: All we would need to know from you in order to calculate simple time constant probabilities as shown above is:

- the size of the target cohort
- the number of observed events
- the time-frame during which these events occurred

Obviously, for calculating incremental impact we would need to derive probabilities both for the intervention and a standard care alternative!
1) Do you have data for calculating simple time constant transition probabilities as shown before? i.e.:

- the size of the target cohort
- the number of observed events and
- the time-frame during which these events occurred

for both intervention and standard care alternative

2. For which clinical events (e.g. incidence of target disease, recovery, mortality etc.) do you collect such data?
Time dependant probabilities

We will now introduce a few options to calculate slightly more realistic probabilities to populate the model with data.

We relax the assumption that probabilities do not change with time.

For instance, consider mortality rates: as people grow older, they obviously face an increasing probability to die from various causes.

The two options we will consider are:

- **Life-table approach** and
- **Functions** (i.e. survival curves) fitted to individual patient data (IPD)
**Time dependant Probabilities**  
**Life-table approach**

**Example:** A commitment aims to reduce the burden from diabetes type II by changing eating habits and the lifestyle of individuals in a Belgian sample. Baseline mortality is assumed to be age-dependant.

**Question:** How can we populate the model with data for the time-dependant probability $P_1(t)$ to move from 'baseline' to 'dead'?
**Time dependant Probabilities**

*Life-table approach*

**Answer:** If no other data is available, could start with information provided by statistical databases, which will also be provided in the planned tool. (However, it will be possible to update values with your own data, if available)

The model would then 'pick' the appropriate value for $P_1(t)$ depending on the respective model-cycle $(t)$
Time dependent Probabilities
Life-table approach (for a Belgian general population sample 60+)

<table>
<thead>
<tr>
<th>Age</th>
<th>Time (t) (Cycle Nr)</th>
<th>P(t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>1</td>
<td>0.007874</td>
</tr>
<tr>
<td>61</td>
<td>2</td>
<td>0.008423</td>
</tr>
<tr>
<td>62</td>
<td>3</td>
<td>0.009202</td>
</tr>
<tr>
<td>63</td>
<td>4</td>
<td>0.009917</td>
</tr>
<tr>
<td>64</td>
<td>5</td>
<td>0.010576</td>
</tr>
<tr>
<td>65</td>
<td>6</td>
<td>0.011159</td>
</tr>
<tr>
<td>66</td>
<td>7</td>
<td>0.013726</td>
</tr>
<tr>
<td>67</td>
<td>8</td>
<td>0.013384</td>
</tr>
<tr>
<td>68</td>
<td>9</td>
<td>0.01495</td>
</tr>
<tr>
<td>69</td>
<td>10</td>
<td>0.01675</td>
</tr>
<tr>
<td>70</td>
<td>11</td>
<td>0.018929</td>
</tr>
<tr>
<td>71</td>
<td>12</td>
<td>0.017762</td>
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<tr>
<td>72</td>
<td>13</td>
<td>0.019675</td>
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<tr>
<td>73</td>
<td>14</td>
<td>0.023479</td>
</tr>
<tr>
<td>74</td>
<td>15</td>
<td>0.024834</td>
</tr>
<tr>
<td>75</td>
<td>16</td>
<td>0.026727</td>
</tr>
<tr>
<td>76</td>
<td>17</td>
<td>0.030107</td>
</tr>
<tr>
<td>77</td>
<td>18</td>
<td>0.034642</td>
</tr>
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<td>78</td>
<td>19</td>
<td>0.037974</td>
</tr>
<tr>
<td>79</td>
<td>20</td>
<td>0.04147</td>
</tr>
<tr>
<td>80</td>
<td>21</td>
<td>0.051121</td>
</tr>
</tbody>
</table>
Discussion

Do you follow up a particular patient cohort regularly over a longer time period?

Which health outcomes do you record? e.g.

- Death rates (disease specific vs. baseline)
- Incidence of a certain health event (which event?)

If this data is not collected in your commitment, which sources would you advise using instead (e.g. regional / national data bases etc.)?
Time dependant Probabilities
Time dependency using functions

We have, thus far, looked into different methods to derive transition probabilities for populating model parameters which rest on summary data.

We will now briefly consider a situation when individual patient data (IPD) on the time to a given event is available from your commitment.

This would allow estimating transition probabilities as a function of time and even extrapolating beyond the observed period.

The conceptual framework is known as 'survival analysis', however, this does not imply that it only applies to mortality data.

The concept is applicable to all transition probabilities, provided we have adequate data on patient level!
**Time dependant Probabilities**

**Time dependency using functions**

**Question:** What data do we need?

**Answer:** We need patient-level 'time to event' data!

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**Kaplan Meier plot of overall patient survival with and without intervention to improve patient adherence to medicines**

- **With intervention to improve adherence**
- **Without intervention to improve adherence**

---

**Proportion alive**

**time**
In your commitment, do you collect and record **individual patient information on the time to a particular event** that could be used to estimate time dependant transition probabilities for our model?

Which events do you consider?
Any questions on Transition Probabilities?
Wrap-up and Next Steps

• Better understanding of data availability within commitments
  • Resource use
  • HRQoL
  • Probabilities

• Closer cooperation with commitments interested/willing to participate in the further development

• Tool development / case studies
Thank you

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