



Digital Transformation in Healthcare

## Health Economic Evaluation in EPI

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**Research area:** My research is focusing on investigating the use of new disruptive methodologies and technologies in healthcare using (near real-time) data gathering and data analytics, high-performance- computing (HPC), internet of things, distributed machine learning and their impact on traditional business models of healthcare providers, industrial suppliers, and healthcare insurance companies



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# What is health technology assessment & Health economic evaluation?

Health Technology Assessment (HTA) is the systematic evaluation of properties, effects, and/or impacts of health care technology. It includes medical, social, ethical, and **economic dimensions (Health economic evaluation)**

## Why it is important?

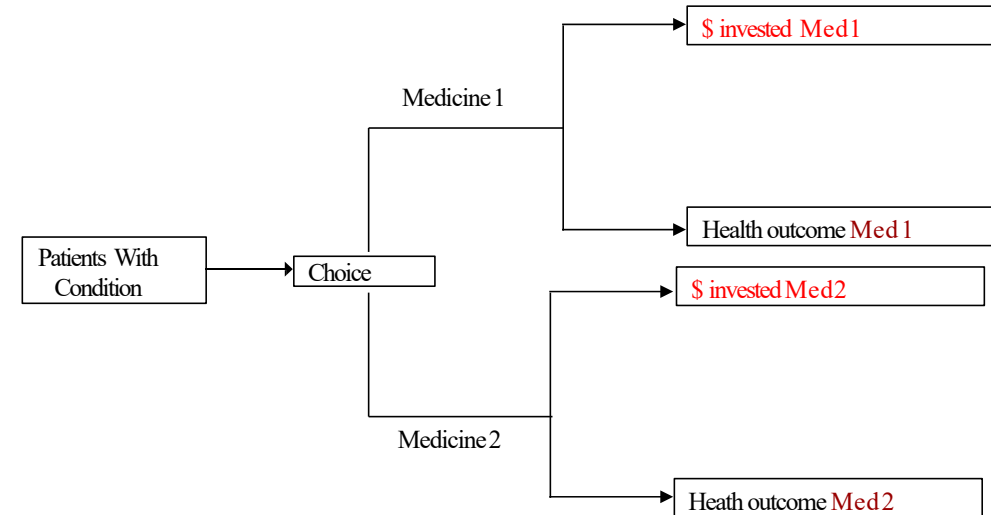
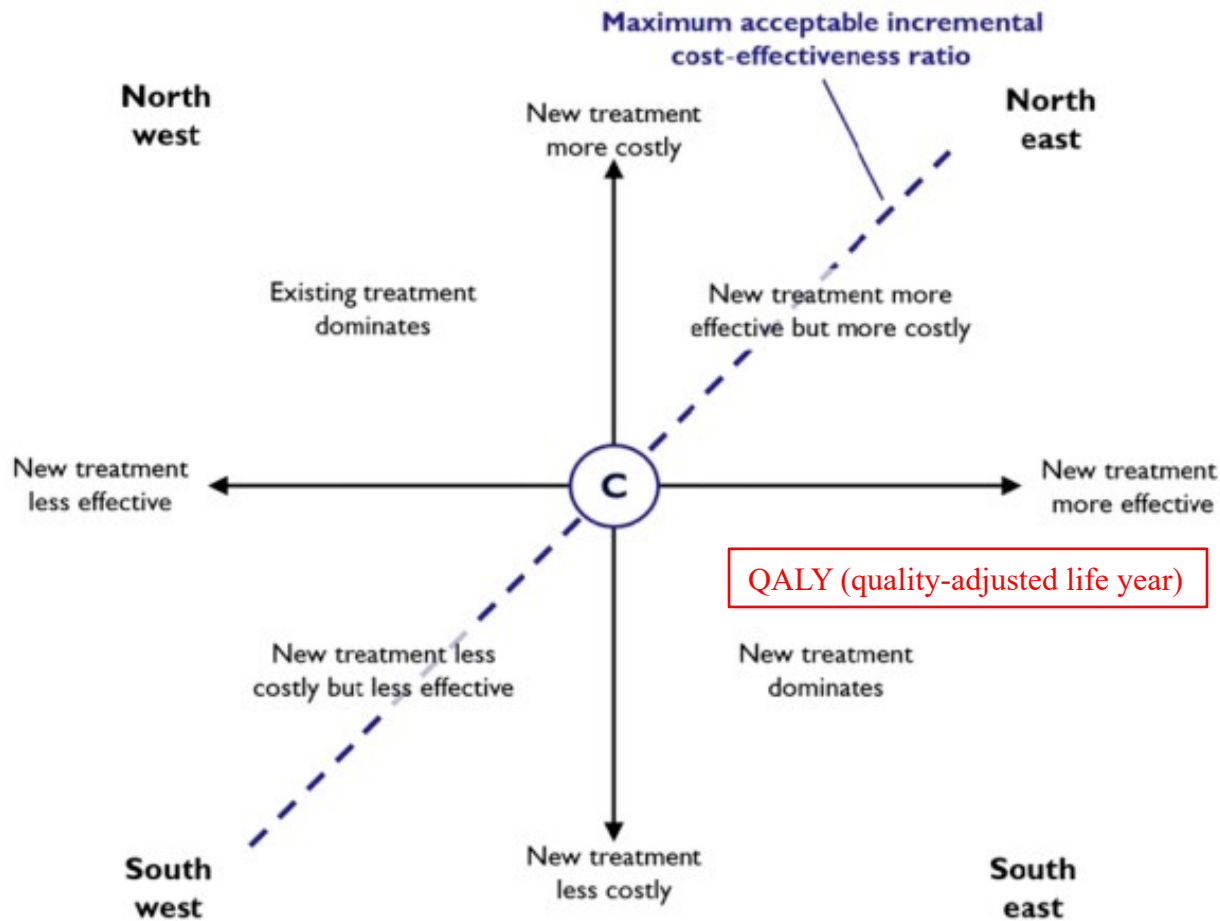
The purpose of HTA is to provide policymakers with evidence to inform decision-making and develop guidance on the reimbursement and administration of new health technologies in a national healthcare system. As such, HTA is regarded as **a bridge between research evidence and health policy**

## Introduce Cost-Effectiveness analysis

A method used to compare the application of two or more **health technology strategies** for a particular **scenario** that yield quantifiable **health outcomes** and may differ in their **resource implications**.

- ‘**Health technology strategies**’ can refer to diagnostic tests, drugs, medical devices, prediction algorithms, surgery, or multifaceted interventions
- ‘**Scenarios**’ can refer to a disease state for a single patient or the aggregate health status for groups of patients (grouped by clinics, hospitals, regions, etc.)
- ‘**Resource implications**’ usually refers to the monetary cost of applying a given technology within the scenario....

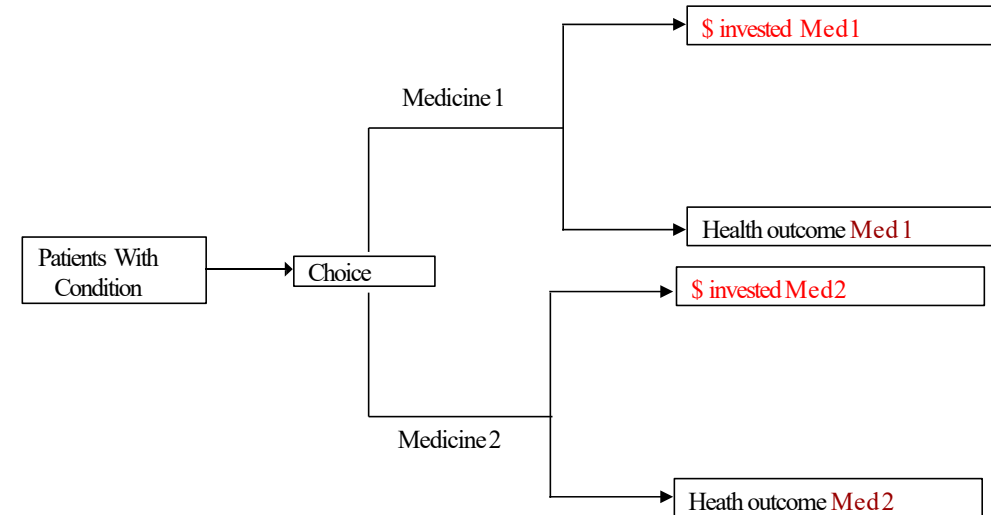
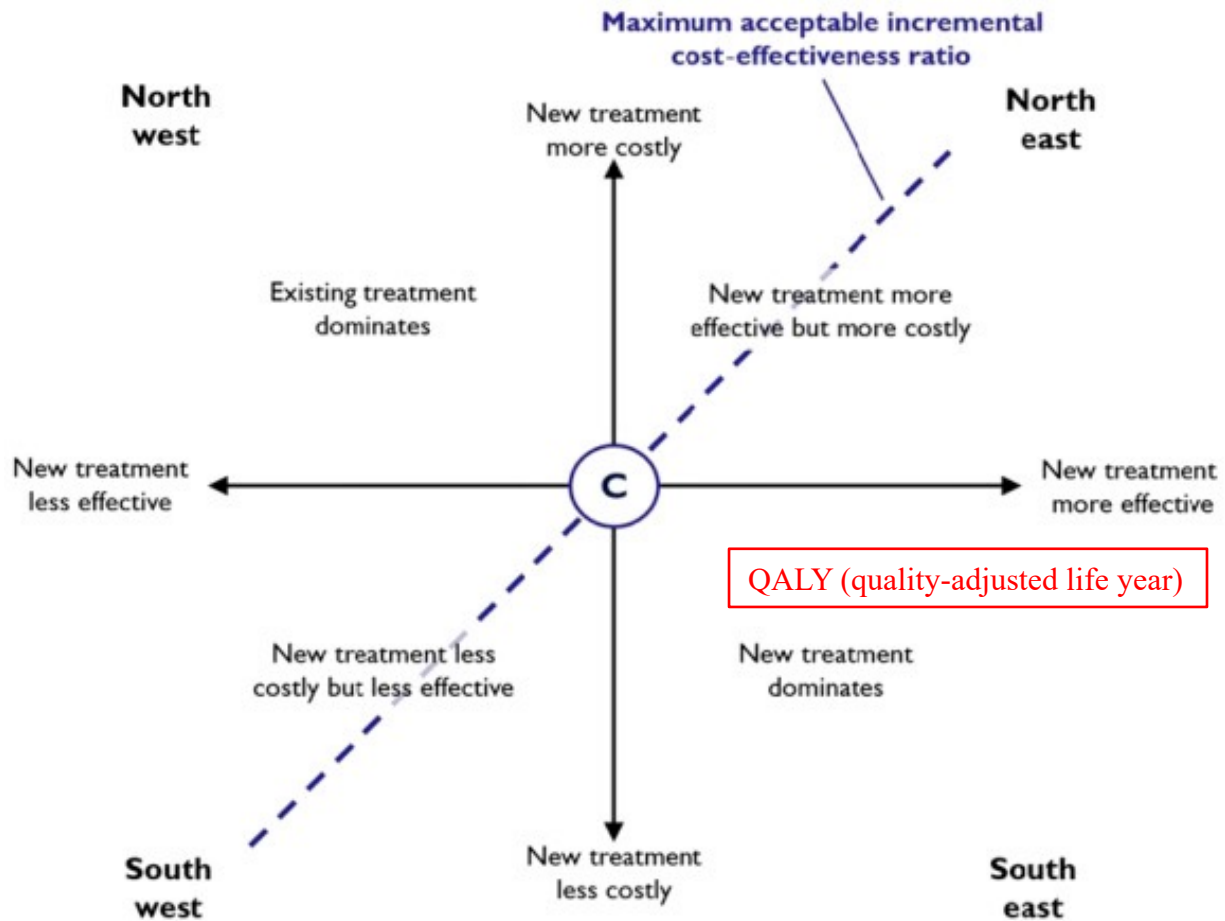
# Introduce Cost-Effectiveness analysis of New Treatment



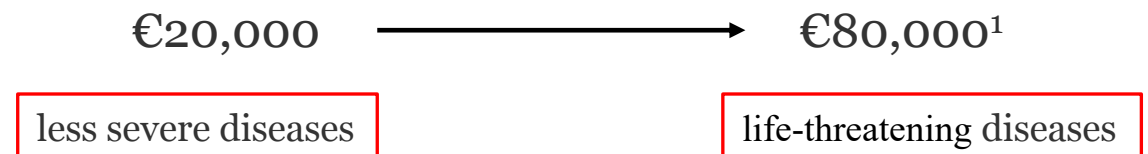
- **Incremental cost-effectiveness ratio (ICER)**

$$ICER = \frac{Cost_{med1} - Cost_{med2}}{QALY_{med1} - QALY_{med2}}$$

## Introduce Cost-Effectiveness analysis of New Treatment



- **ICER Threshold Netherland<sup>1</sup>**



<sup>1</sup> Cost-effectiveness in practice by Zorginstituut Netherland : <https://english.zorginstituutnederland.nl/binaries/zinl-eng/documents/reports/2015/06/16/cost-effectiveness-in-practice/Cost-effectiveness+in+practice.pdf>

## An example : Computed Tomography To Strength (CT2S)

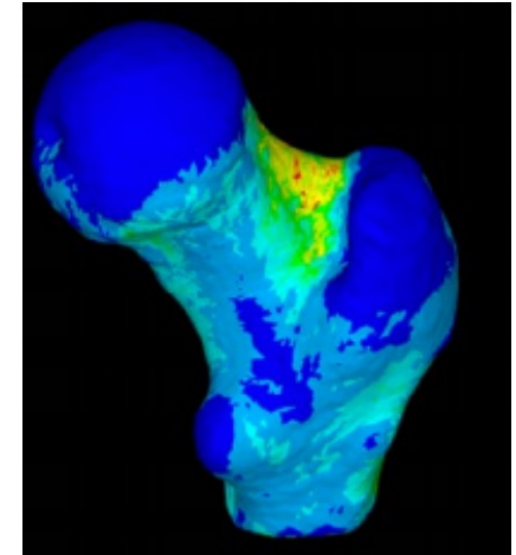
CT2S service provides computer-based estimation of the strength of human bone, using non-invasive medical imaging (CT scan)<sup>1</sup>

## Performance of DXA and CT2S in identifying osteoporotic hip fractures

Tested with Sheffield cohort (98 subjects, 49 osteoporotic hip fractures)<sup>2</sup>

		Mean	CI (95%)	SD
<b>DXA (T score = -1.41)</b>	<b>sensitivity</b>	0.66	[0.524 - 0.796]	0.0696
	<b>specificity</b>	0.57	[0.426 - 0.711]	0.0726
		Mean	CI (95%)	SD
<b>CT2S ARF0 (threshold 37.4%)</b>	<b>sensitivity</b>	0.82	[0.753 - 0.918]	0.0420 <sup>a</sup>
	<b>specificity</b>	0.78	[0.634 - 0.865]	0.0589 <sup>a</sup>

<sup>a</sup>SD is calculated by dividing the length of the confidence interval by 3.92

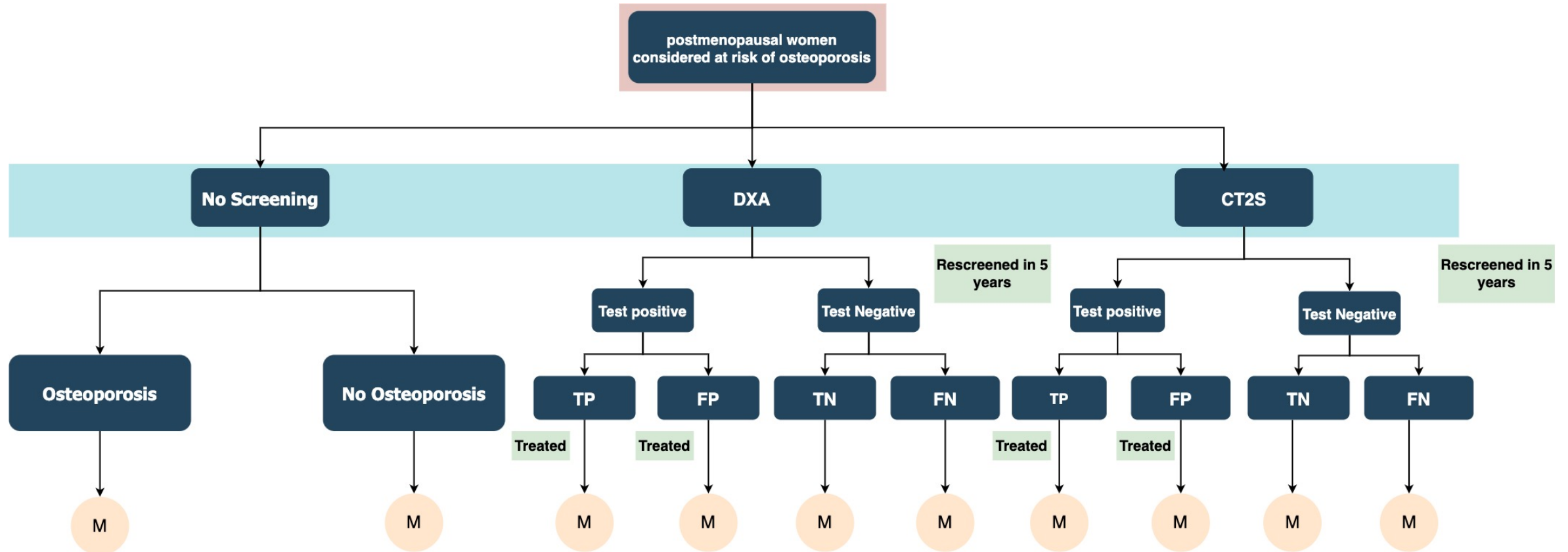


\* Picture showing the location of fracture for the loading case with minimum strength. (Loading Condition : Stance)

## How cost effective it would be ?

- **Clinical Practice:** Provide more accurate bone strength estimation than currently used osteoporosis screening tools like DXA

## An example : Diagram of Osteoporosis screening model

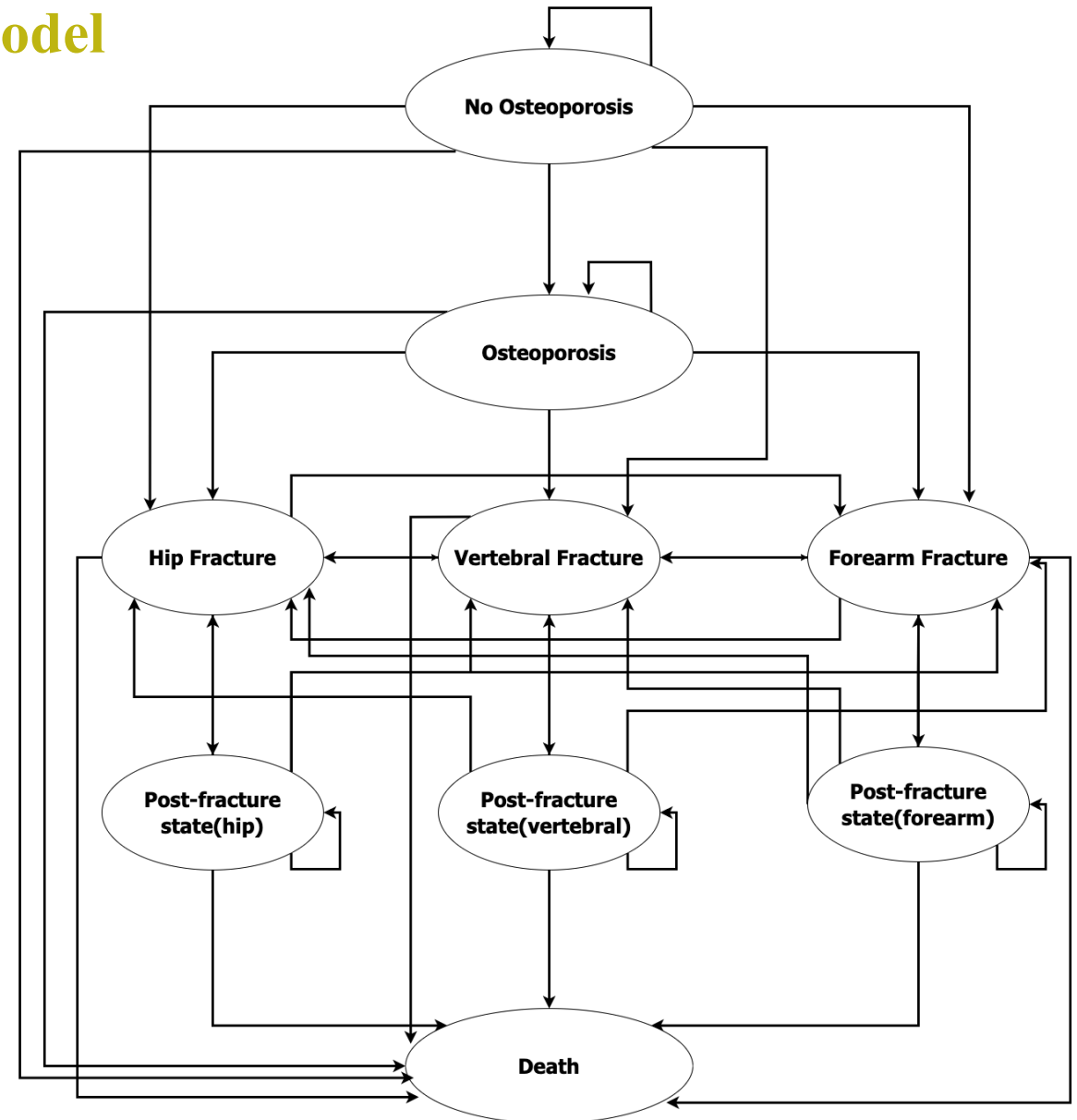


\*TP = True Positive, FP = False Positive, TN = True Positive, FN = False Negative, M = Markov Chain



## An example : Structure of the Markov model

Incremental cost and health utility (QALY) throughout patient journey will be calculated across different treatment, screening or intervention strategies.



# Model input data

## Parameters

Type of Parameters
Medication Efficacy
Screening accuracy
Prediction accuracy
Transition Probability
Resource use or unit cost
Health Utility value
Adherence Data
Relative risk
.....

## Data Sources

- Published literature (RCT, Meta-Analysis ...)
- Federal Departments (Department of Health, Statistics)
- Insurance & Hospital bills
- Expert Opinion
- ...

## Some Cost-effectiveness studies of prediction algorithm for various disease scenarios

### Health economic evaluation of prediction model is emerging....

- Hill, N. R., Sandler, B., Mokgokong, R., Lister, S., Ward, T., Boyce, R., Farooqui, U., & Gordon, J. (2020). Cost-effectiveness of targeted screening for the identification of patients with atrial fibrillation: evaluation of a machine learning risk prediction algorithm. *Journal of Medical Economics*, 23(4), 386–393. <https://doi.org/10.1080/13696998.2019.1706543>
- Zomer, E., Osborn, D., Nazareth, I., Blackburn, R., Burton, A., Hardoon, S., Holt, R. I. G., King, M., Marston, L., Morris, S., Omar, R., Petersen, I., Walters, K., & Hunter, R. M. (2017). Effectiveness and cost-effectiveness of a cardiovascular risk prediction algorithm for people with severe mental illness (PRIMROSE). *BMJ Open*, 7(9), e018181. <https://doi.org/10.1136/BMJOPEN-2017-018181>
- Schwendicke, F., Rossi, J. G., Göstemeyer, G., Elhennawy, K., Cantu, A. G., Gaudin, R., Chaurasia, A., Gehrung, S., & Krois, J. (2021). Cost-effectiveness of Artificial Intelligence for Proximal Caries Detection. *Journal of Dental Research*, 100(4), 369–376. <https://doi.org/10.1177/0022034520972335>

And more .....

## Some discussion points and clarifications

### Where are the gaps we think within EPI ?

One missing puzzle would be to show the promise of the prediction model and following intervention by addressing the direct or intended effects of the new technology together with the corresponding costs. This can show how new medical solutions can take advantage of advanced data sharing infrastructures to improve care and generate new business value in healthcare and how data sharing infrastructures play a key role in it.

### Which added value can we offer ?

We will conduct Cost-Effectiveness analysis for the adaptive health diagnosis / optimized intervention enabled by prediction model. Our aim is to provide a robust analytical results for policy makers and regulators to assess if the new technology are worth to be introduced.

### What are we looking for ?

Proper use cases to collaborate and produce joint publications if we end up with interesting results.

### Any overlap ?

Let's discuss !

**Thank you !**

**Questions?**

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