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OBJECTIVE
To evaluate the cost-effectiveness of a machine learning-based risk identification tool for Alzheimer's disease (AD).

ANALYSIS
The use of AD risk prediction tool was compared to no risk prediction in state-transition modelling setting.

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KNOWLEDGE GAINED
The use of AD risk prediction tool was highly likely to be cost-effective in all scenarios.

KEY MESSAGE
The use of the AD risk prediction tool can be beneficial in an unselected population of over 65 years of age.

Predictive Cost-Effectiveness Evaluation of Using a Machine Learning-Based Alzheimer's Disease Risk Prediction Tool for Users of Social and Health Services Aged over 65 in Finland

Haikonen-Salo L[1], Jalkanen K[1], Ihalainen J[2], Forsberg MM[2], Soini E[1]

[1] ESiOR Oy, Kuopio, Northern Savo, Finland, [2] VTT Technical Research Centre of Finland, Kuopio, Northern Savo, Finland

Contact person and presenter: Erkki Soini, ESiOR Oy, Tulliportinkatu 2 LT4, 70100 Kuopio, Finland. erkki.soini@esior.fi. +358 400 533 971, https://esior.fi/en/

OBJECTIVE

- The number of people with memory disorder is estimated to increase from 57 million in 2019 to up to 153 million in 2050.[1]
- Early identification, diagnosis, and treatment of memory disorders have many benefits through longer time to adjust and plan, and more timely and thus effective drug treatment initiation with drugs already in use.[2,3] The importance of early diagnosis is recognized in the updated guidelines.[4]
- In addition, the development and market authorization of disease-modifying drug treatments that influence the progression of Alzheimer's disease (AD) are already quite advanced.[5]
- We assessed the added value of emerging machine learning and potentially AI-based risk identification tools when using real-world patient data to predict AD risk. The aim of the study was to find out how accurate the AD risk prediction tool should be and how early it should be used so that its implementation can be efficient from a healthcare perspective.

METHODS

The methods of the economic evaluation are summarized in the table below using the PICOSTEPS framework (Table 1).[6]

Table 1. Summary of evaluation framework.

PICOSTEPS [6]	Definition of method
Patients / Population	Unselected real-life (RL) population of individuals **at least 65 years old** using social and health services and without diagnosed memory disorder.
Intervention	Use of an **AD risk prediction tool**, and a follow-up for the deemed high-risk group for early diagnosis of AD and initiation of drug treatment affecting the progression of the disease in MCI and mild stages of AD.
Comparator	No AD prediction tool, AD diagnosis according to RL situation and initiation of drug treatment affecting the progression of the disease in MCI and mild stages of AD.
Outcomes	Incremental cost-effectiveness ratio (ICER, € per quality-adjusted life-year [QALY] gained in year 2021 value), cost-effectiveness plane, and probability of cost-effectiveness at different willingness-to-pay levels.
Setting	**Cost-effectiveness** modelling using a cohort transition model (Figure 1). Different scenarios (AD prediction tool's accuracy 50-90%; timing 1-5 years before RL diagnosis) were modelled.
Time	**15 years.** 3% per annum discounting.
Effects	Outcomes were modified by the **time of prediction** compared to RL diagnosis and **accuracy of prediction** and modelled through costs (use of the risk prediction tool, follow-up cost, drug treatment cost, imaging cost, stage-related AD treatment cost), health-related quality of life (HRQoL), disutility related to different stages of AD, and impact of drug treatment (slowing of the disease progression [HR 0.728; 95% CI 0.596–0.861])[5].
Perspective	Direct costs of the **payer of health services**.
Sensitivity analyses	Probabilistic sensitivity analysis (PSA) including age, AD-related costs (identification, monitoring, drug treatment, other treatments, imaging), effectiveness of AD drug treatment, and baseline HRQoL.

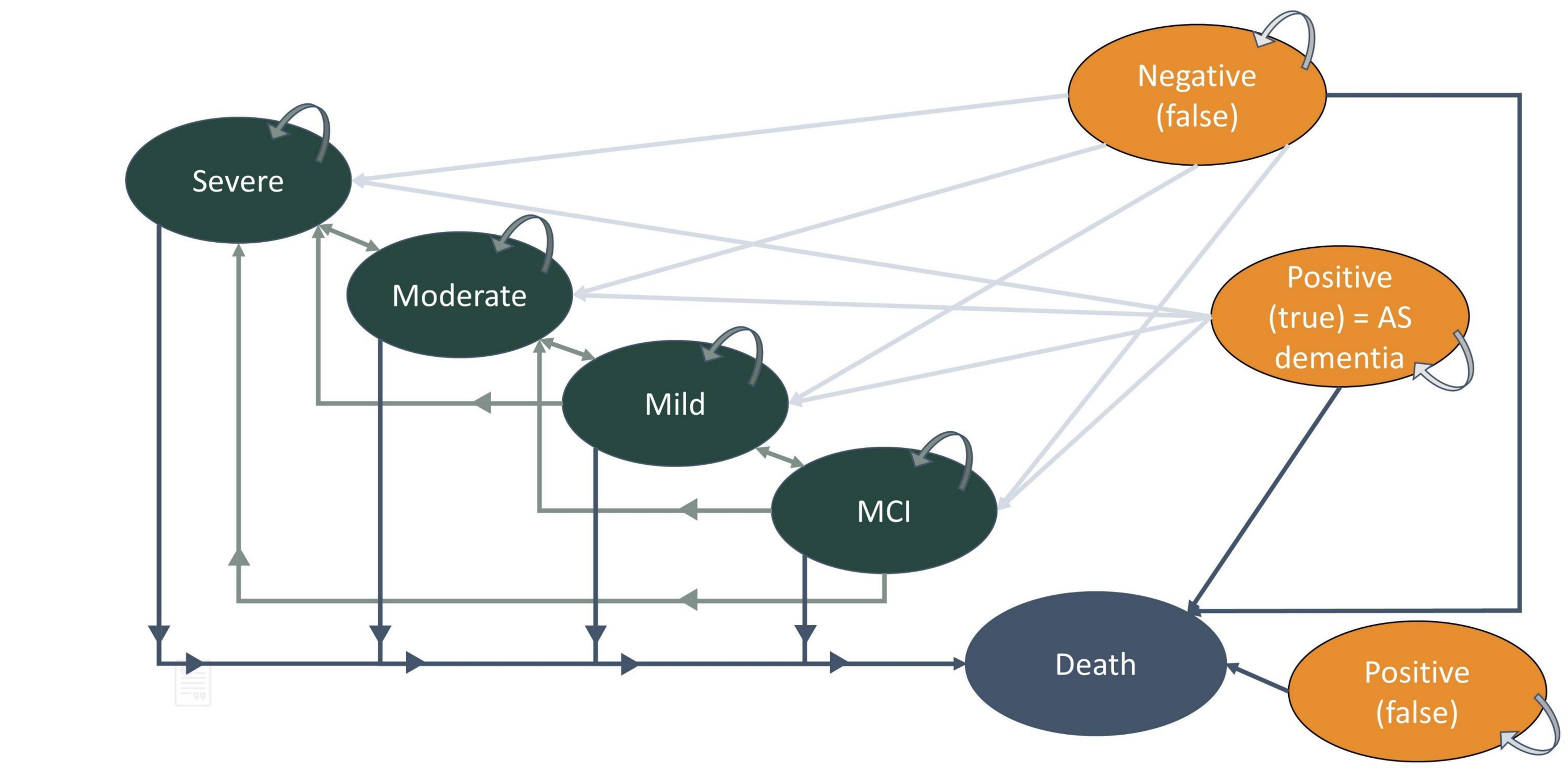

Figure 1. Structure of the state-transition model. The orange circles are the starting states of the model, into which the population is initially divided based on the accuracy of the risk prediction model. For true positives and false negatives, the person was certain to develop AD. MCI, mild cognitive impairment; AS, asymptomatic dementia, preclinical memory disorder.

RESULTS

- In most of the scenarios, including the base case analysis (80% and prediction time 3 years before diagnosis), the average expected total lifetime costs were lower and QALYs greater in the intervention group compared to the control group (Table 2).
- Intervention group produced more QALYs in every scenario. Expectedly, cost difference between intervention and control group decreased with improving accuracy of the prediction model in scenarios where ICER was positive.

Table 2. Incremental cost-effectiveness ratio (€/QALY) in different accuracy and time scenarios. The intervention was both more effective and cost reducing (dominated) in most of the scenarios.

Accuracy	Time (years before diagnosis)				
	1	2	3	4	5
50 %	Dominates	Dominates	1 503	8 191	15 996
60 %	Dominates	Dominates	Dominates	6 026	13 513
70 %	Dominates	Dominates	Dominates	4 480	11 739
80 %	Dominates	Dominates	Dominates	3 321	10 409
90 %	Dominates	Dominates	Dominates	2 419	9 375

- PSA of the base case (80 % and 3 years) showed strong correlation between QALYs and costs, with mean ICER close to zero (Figure 2).
- The probability of the intervention's cost-effectiveness was approximately 55% at willingness-to-pay of 0 €/QALY, approximately 80% at the probable willingness-to-pay value of 20 000 €/QALY and 100% at willingness-to-pay of 30 000 €/QALY.

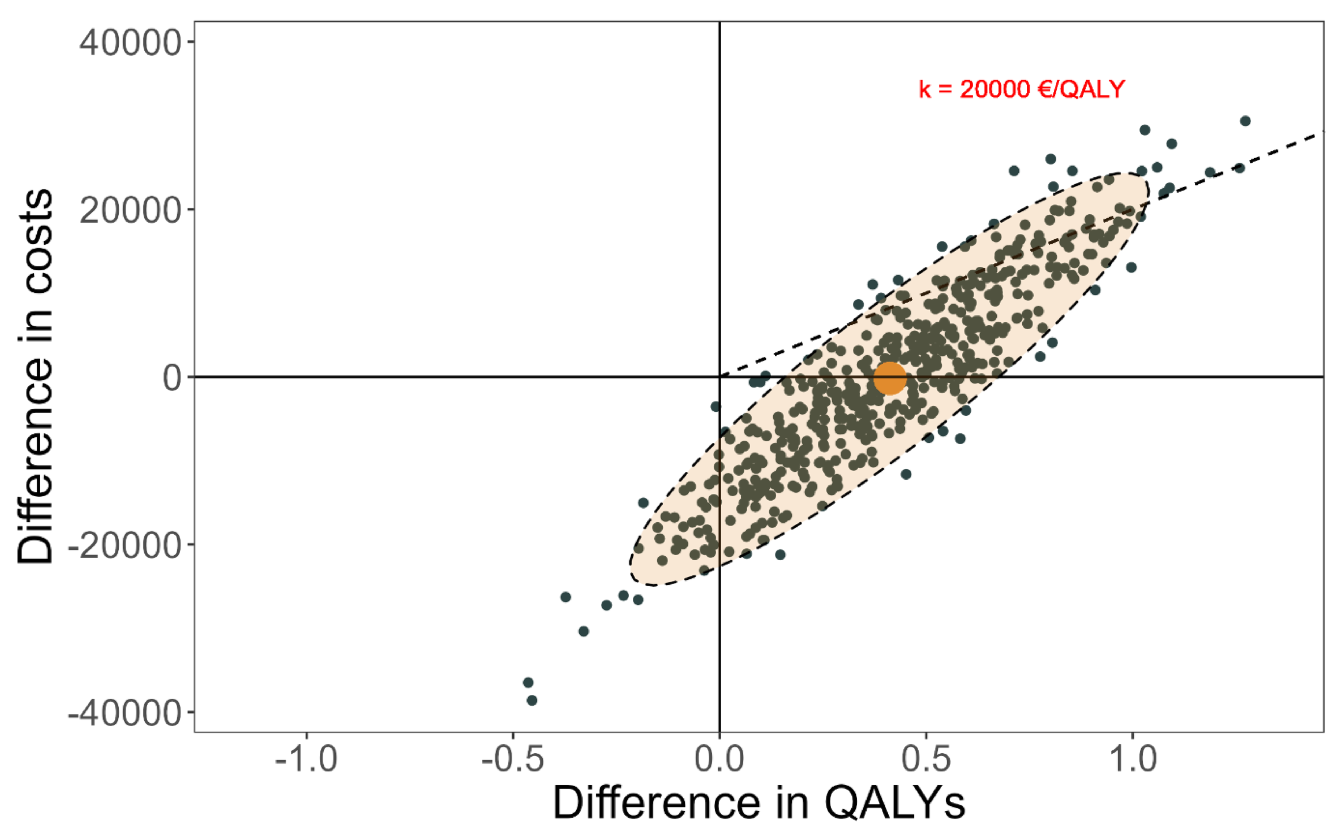

Figure 2. Cost-effectiveness plane from the base case analysis (80% and 3 years), where the straight dashed line indicates the willingness-to-pay limit of €20,000/QALY and the orange dot the average PSA ICER.

CONCLUSIONS

- **The use of the AD risk prediction tool has a very high probability of being cost-effective compared to standard practice in an unselected population of users of health services over 65 years of age.**
- **Future studies should investigate the actual benefits of monitoring AD incidence after risk prediction.**

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