

ECONOMIC IMPACT OF ALZHEIMER'S DISEASE EARLY DETECTION IN CZECHIA

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Abstract

The aim of this paper is to model the costs of Alzheimer's disease in Czechia in the event that it was attempted to detect the disease early after its onset. Worldwide, Alzheimer's constitutes a significant cost burden for health care budgets. The main cost drivers are the long-term stays of patients in institutions providing care and the opportunity costs of family caregivers. Many studies have proved that an early detection and a timely treatment of the disease are able to slow down its progression and reduce thus the life-long costs of the patients. In Czechia, no major effort to detect Alzheimer's early can be observed and a significant share of cases remain undiagnosed. Using the Monte Carlo simulation method, we estimate the costs if Alzheimer's started to be detected shortly after its onset. Subsequently, we compare these costs with the current situation in which the disease tends to be detected in its later stages.

Key words: Alzheimer's disease, costs of treatment, Monte Carlo simulation, health economics, cost-effectiveness

JEL Code: C15, I10, I18

Introduction

Alzheimer's disease (AD) represents a major health issue worldwide as well as in Czechia. According to estimates of the Czech Alzheimer Society, 153 thousand people suffered from dementia in the country in 2014 (about 1.5% of the population) and approximately 60% of them from AD. The trend is clearly increasing over time; due to aging of the population, the number of AD patients is supposed to reach 200 thousand by 2030. Although early detection and treatment of AD can significantly slow progression of this neurodegenerative disease, only a quarter of people with AD is actually diagnosed and treated in Czechia (Mátl & Mátlová, 2015). Moreover, the diagnosis usually comes years after the disease onset – in a nonnegligible number of cases only once the patient is admitted to institutional care with a severe cognitive impairment (Luzny et al., 2014).

Alzheimer's disease constitutes an enormous financial burden for health care systems and family budgets. The major part of the burden is represented by indirect costs, i.e. costs of non-medical care. In Czechia, average monthly costs of care for AD patient amount to €1,950 (Holmerová et al., 2016), only €230 (12%) of which is spent on health care. Foreign economic literature has recently proven that early diagnosis cost-effectively mitigates this burden, mainly because early diagnosed patients spend more time in better health state requiring less assistance with basic activities (Getsios et al., 2012; Weimer & Sager, 2009). The aim of the current study is to model lifetime costs of AD patients in case that early detection was implemented in Czechia, and to compare these costs with care as usual.

1 Methods

We build our model on the methodology developed by Weimer and Sager (2009) who use Monte Carlo simulation to estimate the outcomes of early detection and treatment in the United States (hereinafter called the background study). All subjects entering simulation suffer from Alzheimer's disease – we vary the time when they are diagnosed and the treatment is initiated (if so). The main parameter of the model is progression of the disease that we, like the background study, take over from the existing medical literature. Disease progression is measured in points earned from the Mini Mental State Examination test (MMSE) that is widely used for assessment of cognitive functions. According to the MMSE score, a patient is classified as suffering from mild (MMSE 28 – 21), moderate (MMSE 20 – 11) or severe (MMSE 10 – 1) dementia. MMSE scores as well as incurred costs are updated on a yearly basis. To determine the probability of a patient dying we use Czech life tables considering a 2.1. times higher death risk (Fitzpatrick et al., 2005) for AD patients.

In accordance with the background study, we use Mean and Lopez decline schemes (Lopez et al., 2005). The Lopez scheme assigns patients probabilities of slow or fast progression, and for each group a distribution of MMSE decline exists. Treated patients have higher probability of slow cognitive decline than untreated. The Mean decline scheme is a product of simplification where the decline for treated and untreated patients is drawn from different distributions without considering a chance of slow progression for untreated patients. As a result, the Lopez scheme gives a more conservative annual difference between treated and untreated patients: 1.2 MMSE points in comparison to 1.9 MMSE points in the Mean scheme. Although representing a major simplification, the Mean decline scheme produces a yearly decline within boundaries identified by other medical studies 1.7 – 2.3 MMSE points (Matthews

et al., 2000; Sabbagh et al., 2006; Small et al., 2005). Both decline models are described in detail in Table 1 further below.

Table 1: Overview of decline schemes parameters

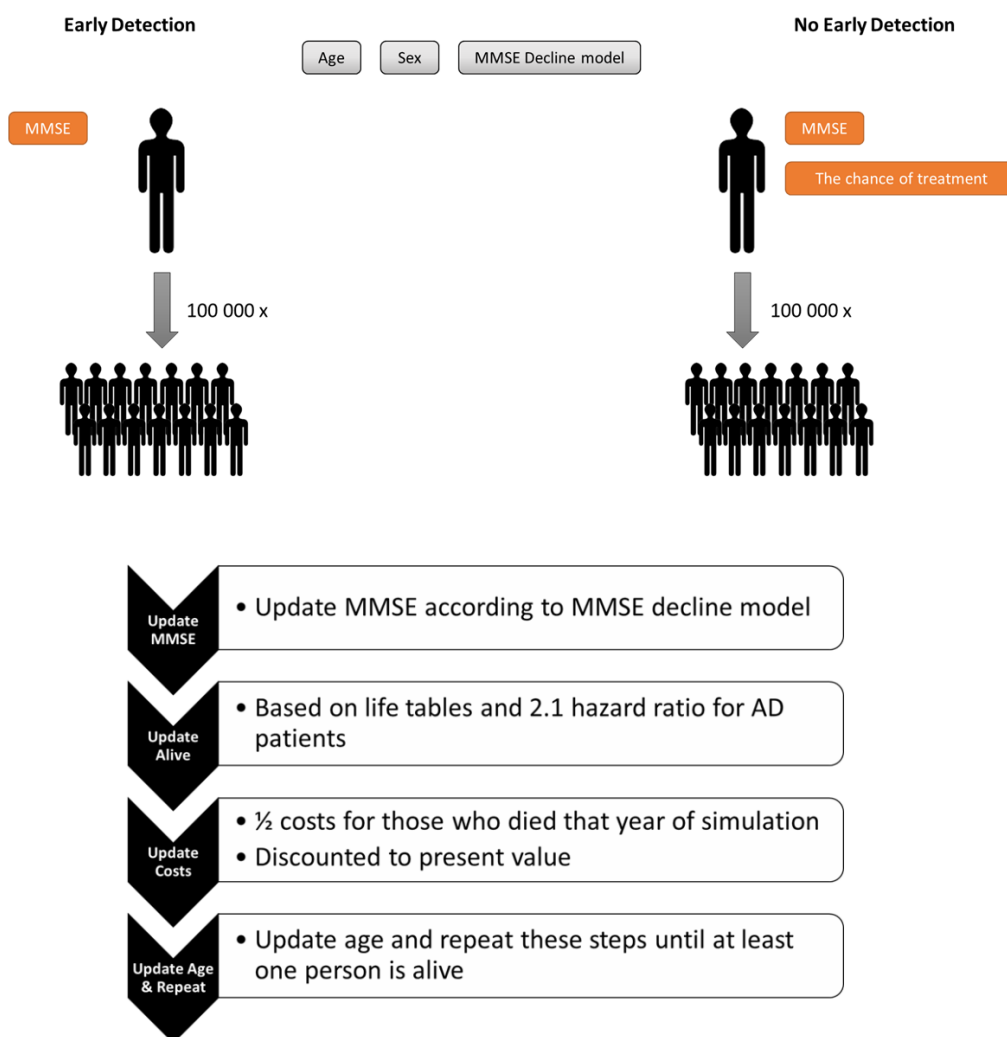
Parameter:		Source:
MMSE decline model/year		
<i>Mean decline model:</i>		
Annual decline without treatment	Normal distribution with a mean of 3.5 and a standard deviation of 1.5, with negative truncation	Weimer and Sager (2009)
Annual decline with treatment	Normal distribution with a mean of 1.5 and a standard deviation of 1.5, with negative truncation	
<i>Decline Model of Lopez:</i>		
Probability of being slow progressor without treatment	0.39	Lopez et al. (2005)
Annual decline of slow progressors without treatment	Uniform distribution over range of – 1 to 2: mean, 0.5	
Annual decline of fast progressors without treatment	Uniform distribution over range of 3 to 6.8: mean, 4.9	
Probability of being slow progressor with treatment	0.60	
Annual decline of slow progressors without treatment	Uniform distribution over range of – 1 to 2: mean, 0.5	
Annual decline of fast progressors without treatment	Uniform distribution over range of 3 to 5: mean, 4.0	

Source: Weimer and Sager (2009) and own adjustments

The model has two decision branches: an early detection branch and a branch representing usual care without early detection. In each branch, we simulate 100,000 times disease progression of a patient until her death. Starting parameters are age, sex and MMSE score. With an early detection, patient is diagnosed in the mild state of dementia and a treatment by the cholinesterase inhibitor donepezil is commenced. Without early detection, AD is diagnosed when the MMSE score drops to 19; moreover, after being diagnosed, only 25% of patients undergo treatment. This picture of the usual care is taken over from the background study. Nevertheless, it appears to reflect also the Czech reality as only 25% of all Czech patients

actually get to be treated (Mátl & Mátlová, 2015). The scheme of the model is depicted by Figure 1.

Figure 1: Simulation scheme



Source: own illustration

Cost information used in the model were acquired from existing literature regarding dementia in Czechia. We consider three types of costs: costs of annual medical checks, costs of medication and costs of care. Mohelska et al. (2015) calculated that costs of medical checks amounted to €94 in the year 2014. The average procedure included two visits of neurologist, twice blood sampling and once sampling of the cerebrospinal fluid. Costs of medication are taken over from a study conducted by Kruntoradova et al. (2015). Their size depends on the drug and dosing prescribed for each of the disease stages. As reported by the Medicinal product database of the State Institute for Drug Control, the yearly costs are €187 and €579.4 for donepezil and memantin, respectively. As regards the costs of care, we rely on the indirect costs

calculated in Holmerová et al. (2016), which include costs of social assistance and loss of productivity of the caregiver. According to this study, annual costs of care amounted to €11,412/22,470/25,867 for patients with mild/moderate/severe dementia. In the simulation, all costs were discounted to the present value of the year 2017 and we calculated with a 2% increase in costs every year.

In our simulation, we do not consider any costs incurred during the diagnosis process. The reason is that for people suffering AD, the costs of diagnosis are negligible in the context of the lifetime costs. What matters are the costs per one patient diagnosed; i.e. how many people need to be assessed in order to diagnose one AD patient in an early stage of the disease. For the United Kingdom, Getsios et al. (2012) estimate that 17 patients need to be assessed to diagnose one case of AD and that the resulting assessment costs of one diagnosis amount to £4,100. However, no similar estimate is available for Czechia, and the issue goes beyond the scope of the presented study.

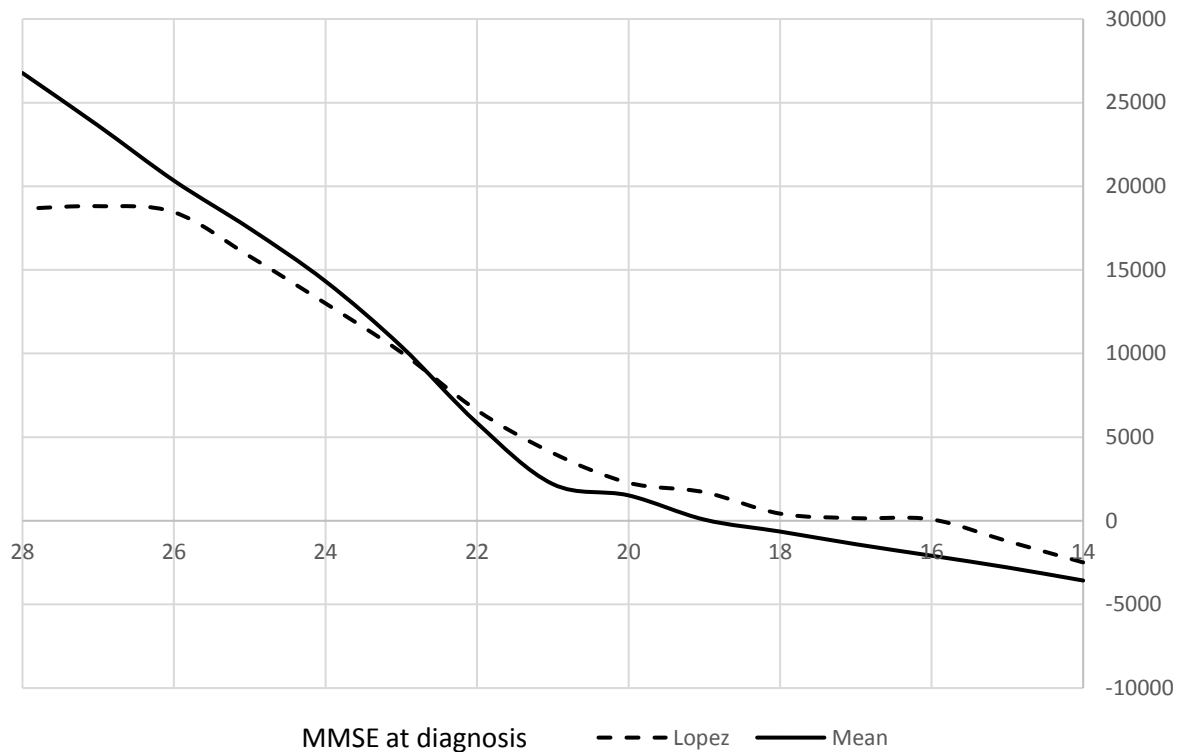
2 Results

The results of our simulation show that early detection and initiated treatment would likely represent a cost-effective strategy in Czechia. If we take an example of a 70-year-old woman, savings are realized in case she is diagnosed before the MMSE score falls under 16 (Lopez decline scheme) or 19 (Mean decline scheme) points. The earlier the diagnose comes and a treatment begins, the higher the monetary savings. It is noteworthy that a MMSE score equal to 19 is currently the moment when patients are actually diagnosed without an early detection scheme. Figure 2 depicts the monetary impact of diagnosis time: horizontal axis refers to the MMSE score at the time of diagnosis and vertical axis shows monetary savings following from early detection and treatment in comparison with care as usual.

For our example case, the average lifetime costs in case of early diagnosis for a 70-year-old woman with MMSE=26 are €255,548 (299,950) according to the Lopez (Mean) decline scheme. This amount can be divided according to its character in costs of medical checks €1,254 (1,251), costs of medication €4,257 (5,077) and costs of care €250,036 (293,622). She spent in average 4.9 (2.2) years living with mild, 2.8 (4.2) living with moderate and 3.2 (4.6) years living with severe dementia. In comparison, the same person's expected lifetime costs without early detection are €273,995 (320,283); costs of medical checks are €137 (249), costs of medication €725 (1,404) and costs of care €273,133 (318,631). She spent 3.6 (1) years living with mild, 2.5 (2.7) living with moderate and 4.7 (7.2) years living with severe dementia. In both cases, she dies aged 81 since treatment does not prolong lifetime, only slows the disease progression

(Getsios et al., 2010). Consequently, early detection saves in this particular case €18,488 (20,333), which is equivalent to approximately 500 – 550 thousand Czech Koruna (CZK).

Figure 2: Monetary benefit (in EUR) of early diagnoses and treatment for a 70-year-old woman with AD



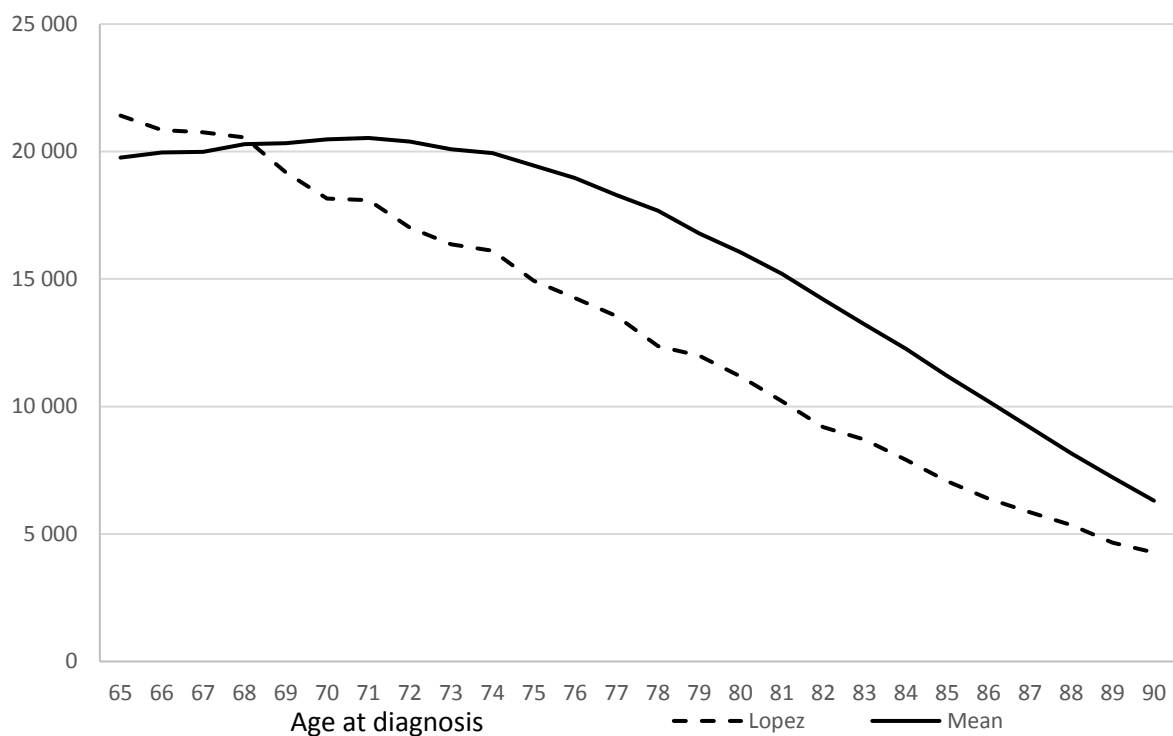
Source: own calculations

The main difference between the branch with and without early detection is in the years spent in better health state. Since milder forms of dementia require significantly less care, also associated costs of care are lower which results into lifetime savings from early detection. This holds true across both decline schemes. The Mean decline scheme suggests higher returns of early detection because this scheme assumes patients to decline relatively faster than Lopez and, thus, to move to moderate dementia almost immediately when there is no treatment. In case Lopez scheme is better representation of reality, the results suggest that treatment would represent cost-effective strategy even if patient is diagnosed and treated already in the state of moderate dementia. In other words, according to results for Lopez decline scheme, it is beneficial to treat all patients even in the absence of early detection.

Figure 3 shows that monetary savings following from early diagnosis (at MMSE equal to 26 points) decrease with the latter onset of the disease but stay positive even for very high ages. For most of the considered ages, the Mean decline scheme again predicts higher returns of early diagnosis. The exception is when the disease onsets before the age of 68 – in that case,

the Lopez decline scheme predicts higher returns of early detection. As before, this is given by the fact that patients declining according to the Mean scheme slip earlier to moderate and severe forms of dementia where they spend a relatively long part of their life, consuming thus expensive care and medication. Lifelong costs of such patients declining according to the Mean scheme are therefore higher than costs of those declining according to Lopez who spend shorter time in the state of severe dementia. It is important to stress that our assumptions regarding mortality fit better to a later than an earlier onset of AD.

Figure 3: Monetary benefit (in EUR) of early diagnoses and treatment for women with MMSE of 26



Source: own calculations

Conclusion

In Czechia, most of patients suffering Alzheimer's disease are undiagnosed or diagnosed late. At the same time, recent foreign studies show that early diagnosis and treatment slow the progression of the disease to the extent that costs of early detection and costs of health-care (treatment) following the detection are overweight by savings from daily-activities assistance. We have collected enough national data from existing domestic evidence to perform a Monte Carlo simulation that is standardly used for this kind of analysis in foreign literature. To our

best knowledge, our model is the first one that attempts to model cost-effectiveness of AD early diagnosis in Czechia.

The results are in line with foreign literature – i.e. early detection prolongs time spent in better health state and decreases lifelong costs of the patients. Specifically, the savings for a 70-year-old woman whom we use as an example through the paper range between €18,500 (CZK 500 thousand) and €20,300 (CZK 550 thousand) respectively for the two variants of disease progression scheme. Monetary savings following from early diagnosis decrease with a latter onset of the disease, holding, nevertheless, positive even for very high ages. This is an important finding since the risk of AD increases with age.

Despite reasonable results, several constraints are linked to our model. First, like the background model developed by Weimer and Sager (2009), we rely on a number of simplifying assumptions such as unified hazard ratio of death for AD patients and a counterfactual case without early detection. Moreover and in contrast to the background model, we do not directly consider institutionalization risk, but instead we use Czech estimates on costs of assistance for daily-activities for different intensities of the disease. However, introduction of the institutionalization risk into our model would likely even increase savings from introduction of early detection. In any case, to model institutionalization, a reliable data about Czech patients are required.

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