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The Cost-Effectiveness of Abdominal Aortic Aneurysm Screening in Estonia

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ABSTRACT

Objective: To assess the cost-effectiveness of population-based abdominal aortic aneurysm (AAA) screening in Estonia.

Methods: A Markov cohort model was used to evaluate the cost-effectiveness of population-based AAA screening compared with no screening. A hypothetical cohort of 6000 men aged 65 was followed for 35 years. Data for disease transition probabilities and quality of life outcomes were obtained from published literature; costs were calculated based on Estonian data. Analysis followed the healthcare payer's perspective using an annual discount rate of 5% for costs and effects. The model evaluated the number of avoidable AAA ruptures and AAA-related deaths and the differences in costs and quality-adjusted life-years (QALYs).

Results: The AAA screening would have prevented 10 AAA ruptures and 6 AAA-related deaths among the cohort of 6000 men, resulting in 23 QALYs gained (0.000378 QALYs per individual). The additional cost of the screening and treatment was €39 429 (€65.4 per individual) with the incremental cost-effectiveness ratio for screening compared with no screening being €17 303 per QALY gained. Although results were sensitive to assumptions regarding health-related quality of life and the models' time horizon, screening was found to be cost-effective with a 99% probability at a willingness-to-pay threshold of €30 000 per QALY.

Conclusion: Population-based AAA screening of elderly men is likely to be a cost-effective measure in reducing the AAA-related disease burden. Given the increase in the overall costs, the actual policy decisions regarding implementing an AAA screening program in Estonia are likely to be influenced by availability of resources as well.

Keywords: abdominal aortic aneurysm, cost-effectiveness, Estonia, health technology assessment, mass screening.

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Introduction

Abdominal aortic aneurysm (AAA) is a focal dilation of the abdominal aorta that is defined with an aortic transverse diameter of ≥30 mm.[1,2] AAA is a common and generally asymptomatic condition that is associated with a considerable health burden because its continuing growth may lead to aortic rupture, a life-threatening condition with an overall mortality of up to 80%.[3] The prevalence of AAA among men aged 65 and older ranged from 4.0% to 8.9% in earlier randomized trials[4-7] but has been declining according to more recent observational data.[8] Given the low AAA prevalence among women (eg, 0.5% in a study by Svensjö et al[9]), the population-based screening is recommended for elderly men only.[2]

According to previous meta-analyses, population-based ultrasonographic screening of 65-year-old men is effective in reducing AAA ruptures and AAA-related mortality.[10,11] This is supported by observational data from Sweden, where Wanhainen et al[8] found a nearly 40% decline in AAA deaths among screening-age (≥65 years) men by 2014 compared to the prescreening period in 2000. Additionally, cost-effectiveness studies published within the past 5 years[12-15] have suggested that the incremental costs of screening-related health gains are acceptable (ie, often below €20 000 per quality-adjusted life-year [QALY] gained).

In accordance with the classic screening criteria, which emphasizes both the presence of an important health problem and the availability of a suitable screening test and treatment,[16] several national screening programs for the early detection of AAA have been implemented in Europe. AAA screening has recently been under consideration in Estonia, a European country with 1.3 million inhabitants. Although there is no first-hand epidemiologic data for Estonia, the estimated prevalence of AAA in Eastern

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Europe is within the range of 911 to 1494 cases per 100 000 among men aged 65 to 69 years.[17] According to Estonian mortality and clinical data, there have been, on average, 31 AAA-related deaths and 80 AAA surgical repairs per year in the 2012 to 2016 period, with the annual direct medical cost of AAA repairs being estimated at €1.5 million Euros.[18]

The aim of this study was to assess the cost-effectiveness of a potential population-based AAA screening program in Estonia. We analyzed the expected lifetime costs and benefits of hospital-based ultrasonographic screening of men aged 65 years compared with no screening to provide evidence for the decision-making process on whether to start a national AAA screening program or not.

Methods

A Markov cohort model was developed to assess the cost-effectiveness of AAA screening compared with no screening. The model followed the natural progression of AAA and simulated the clinical and economic outcomes for a hypothetical cohort of 6000 65-year-old men. The cohort was followed in yearly cycles for 35 years. The validity of the model was evaluated by clinical experts, and it underwent a testing and debugging phase to reveal any errors. The model was created using the TreeAge Pro decision analysis software (TreeAge Software, Williamstown, Massachusetts, USA).

Model Structure

The model consisted of health states defined by aortic diameter and their detection or treatment status (Fig. 1). AAA was defined as an aortic diameter of ≥30 mm and divided into 3 categories: small (a diameter of 30-44 mm), medium (45-54 mm), or large (≥55 mm). Men with an aortic diameter of < 30 mm were assumed not to develop an AAA. The cohort was divided into starting health states based on the prevalence of AAA and their size distribution. Movement between health states was based on state transition probabilities in yearly cycles. AAA can be detected incidentally or by a one-time ultrasonographic screening offered with a screening strategy. Detected cases of AAA of 30 to 54 mm are eligible for annual follow-ups and those with an AAA of ≥55 mm are referred for consideration for elective surgery with either open repair or endovascular repair (EVAR). Open repair is performed on patients with an AAA rupture who reach the hospital alive. Elective repairs with EVAR are followed by regular monitoring of endoleaks using computer tomographic (CT) scans, ultrasonography, or radiography.

Model Parameters

Table 1 presents the main parameters used in the model. Because there is no epidemiologic data on the prevalence of AAA and their size distribution for Estonia, values from a Swedish screening program were used.[14,19] The screening attendance rate was assumed to be 75%. The relatively high compliance is supported by evidence from screening programs in Sweden[8] and the United Kingdom.[26] The sensitivity and specificity of ultrasonographic screening in detecting AAA was assumed to be 100%. The annual incidental detection rate was assumed to be 6% for all sizes of AAA. Based on previous studies,[14,20] it was assumed that 91.8% of large AAAs were accepted for surgery. The proportion of EVARs has been increasing in recent years in Estonia, so 59.4% of planned AAA repairs were performed with EVAR, whereas open repair was used in all of the AAA rupture cases. A Finnish study[21] suggests that 56% of patients with an AAA rupture reach the hospital alive.

Figure 1. Simplified structure of the cost-effectiveness model.