Update on Screening for Abdominal Aortic Aneurysm: A Topical Review

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WHAT THIS PAPER ADDS
Paradoxically, the advent of several national screening programs for AAA coincides with multiple reports indicating a changing epidemiology of the AAA disease: mainly, a decrease in prevalence and mortality from ruptured AAA during the recent decade is evident, with possible implications for the validity of screening for AAA. This review summarizes the most recent data concerning screening for AAA that could affect its justification, and highlights areas with lack of information.

Objectives: Serving as the basis for implementation of several national AAA screening programmes, four large randomised controlled trials provided evidence of a reduction in AAA mortality by ultrasound-based screening among elderly men. Recently, reports of falling AAA prevalence and mortality unrelated to AAA screening have emerged, coinciding with major additional epidemiological changes in the population, as well as improvements in AAA repair. These recent changes may individually, and in concert, affect the rationality of AAA screening. The aim of this paper was to present an up-to-date review of AAA-screening within the context of a rapidly changing AAA epidemiology.

Methods: Topical review of the literature focusing mainly on randomised controlled trials, meta-analyses, and contemporary observational AAA-screening studies.

Conclusions: Summarising RCT results and recent studies; contemporary one-time screening of men for AAA appears highly cost-effective, and seems to remain an effective preventive health-measure. However, several issues regarding screening need to be addressed: most importantly; the current degree of incidental detection of AAAs, the threshold diameter for follow-up, targeted screening in risk groups, and the possible need for re-screening in an elderly population with ever increasing longevity.

INTRODUCTION
Four large randomized controlled trials (RCTs),1–4 randomizing male populations between 1988 and 1999, with AAA prevalence rates of 4–7.2%, to ultrasound based screening or no screening for AAA demonstrated a 40% reduction in AAA specific death.5 The Multicentre Aneurysm Screening Study (MASS),6 the largest RCT, subsequently demonstrated a 3% reduction in all cause mortality after 13 years’ follow up. These results were the basis for initiating national screening programs in Sweden, the UK, and the USA.7,8 Since the time of randomization in these influential studies, reports of a changing epidemiology9–12 of AAA disease have been published, and screening detected prevalence rates of 1.1–1.7% have been reported.3,13,14 Concurrently, major improvements in surgical management of AAA have been established. AAA repair with improved short- and long-term outcomes12,15,16 is offered to healthier17 and increasingly long lived populations.18

The aim of this topical review is to summarize the up to date evidence concerning AAA screening, identify areas lacking information, and to suggest possible directions for future research.

AAA screening evidence base
AAA is a disease exceptionally well suited to screening, and ultrasound based screening for AAA meets all criteria for a screening program according to the WHO.19 After the first population based AAA screening study by Collin et al.,20 in
1988 in Oxford, UK, four large randomized AAA screening trials\textsuperscript{1–4} were launched and delivered their long-term results (Table 1). The trials, conducted in the UK, Denmark, and Western Australia, recruited subjects during 1988–1999, and follow-up data are available up to 15 years.\textsuperscript{6,21–23} A Cochrane meta-analysis of the four RCTs in 2007 concluded that an invitation to screening for elderly men reduced AAA specific mortality by 40\% after approximately 3–5 years of follow up.\textsuperscript{5} A meta-analysis of all cause mortality including all four RCTs found a 2.7\% reduction in all cause mortality after 11–15 years of follow up.\textsuperscript{24}

In the Multicentre Aneurysm Screening Study (MASS), after 13 years, 46 deaths from AAA were prevented by inviting 10,000 men to screening, which implied that 217 men would have to be invited to prevent one death from AAA. Invitation to screening reduced the risk of AAA death by 42\% and 52\% for those actually attending screening. The number of elective AAA repairs conducted in the invited group was twice that of the control group, and the number of emergency repairs was halved.

In Gloucestershire, UK, AAA screening has been offered to 65 year old men since 1990, and after 20 years the number of repairs for ruptured AAA has steadily decreased, indicating a beneficial effect of AAA screening. However, over the same time period the AAA prevalence in 65 year old men fell from 4.8\% to 1.1\%.\textsuperscript{13} Thus, an important contributing cause of decreased AAA emergency surgery may also be an overall decrease of disease occurrence.

A screening trial in Huntingdon 1991–2003, using a stepped wedge design, demonstrated a 45\% AAA mortality reduction, and it was estimated that each prevented death from AAA extended the lifespan by 6.9 years.\textsuperscript{25}

**Abdominal ultrasound and diagnosis**

All four screening RCTs employed a maximum infrarenal aortic diameter of 30 mm or more, measured by ultrasound, as the diagnostic criterion for an AAA. There is, however, no clear consensus on how to measure the maximum aortic diameter.\textsuperscript{26} In MASS inner to inner (ITI) wall measurement was used,\textsuperscript{27} and consequently it is used in the current UK National Health Service AAA screening programme (NAAASP); in Gloucestershire the outer margin of the anterior wall to the inner margin of the posterior wall (leading edge to leading edge [LELE]) was measured,\textsuperscript{28} also adopted in the national Swedish AAA screening programme,\textsuperscript{8} in Huntingdon the outer to outer walls (OTO) was measured, previously used in the UK small Aneurysm Trial and adopted in the current UK intervention criteria.\textsuperscript{29}

A recent study evaluated the various methods of measurement, and concluded that all methods have high variability and that differences between the methods may impact clinical decision making.\textsuperscript{30} Further analysis of data from that study suggested that the estimated AAA prevalence could vary from \(-22\%\) (ITI) to \(+36\%\) (OTO), depending on the method chosen.

**Changing epidemiology and surgical management**

Until the late 1990s and early 2000s, prevalence rates of 4–9\% among elderly men were reported.\textsuperscript{1,4,31–33} Indications of rising prevalence rates were also reported at this time,\textsuperscript{34,35} as well as increasing rupture rates and mortality up until the early 2000s.\textsuperscript{11,36,37} During the past decade, however, multiple studies report prevalence rates below 2\% in 65-year-old men.\textsuperscript{9,13,34} Similar findings of low AAA prevalence (2.3\%) were also evident when screening 70-year-old men in Sweden.\textsuperscript{38} Falling rates of rupture and AAA mortality unrelated to AAA screening were also reported.\textsuperscript{10,11}

The dominating and modifiable risk factor for AAA is smoking.\textsuperscript{9,32,39,40} It has been estimated that smoking causes 75\% of all AAA cases in the population.\textsuperscript{9,32} In many western countries the smoking rate has fallen significantly over the last decades.\textsuperscript{9,11,37} Reduced smoking rates seem to markedly coincide with falling rates of AAA prevalence in Sweden (Fig. 1) a pattern that is evident for AAA mortality as

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**Table 1. Overview of the randomized population based screening trials.**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Chichester, UK</th>
<th>Viborg, Denmark</th>
<th>MASS, UK</th>
<th>Western Australia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number randomized</td>
<td>15,775</td>
<td>12,628</td>
<td>67,800</td>
<td>41,000</td>
</tr>
<tr>
<td>Gender</td>
<td>Men and women</td>
<td>Men</td>
<td>Men</td>
<td>Men</td>
</tr>
<tr>
<td>Age (years)</td>
<td>65–80</td>
<td>65–73</td>
<td>65–74</td>
<td>65–79</td>
</tr>
<tr>
<td>AAA repair at</td>
<td>6 cm</td>
<td>5 cm</td>
<td>5.5 cm</td>
<td>—</td>
</tr>
<tr>
<td>Attendance</td>
<td>68%</td>
<td>76%</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>Prevalence of AAA</td>
<td>4% (7.6% in men)</td>
<td>4%</td>
<td>4.9%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Last follow-up</td>
<td>15 years</td>
<td>14 years</td>
<td>13 years</td>
<td>11 years</td>
</tr>
<tr>
<td>Last published follow-up</td>
<td>2007</td>
<td>2010</td>
<td>2012</td>
<td>2008</td>
</tr>
<tr>
<td>Hazard ratio AAA mortality, last follow-up</td>
<td>0.89 (0.60–1.32)</td>
<td>0.34 (0.20–0.57)</td>
<td>0.58 (0.49–0.69)</td>
<td>—</td>
</tr>
<tr>
<td>Hazard ratio all-cause mortality, last follow-up</td>
<td>1.0 (0.90–1.12)</td>
<td>0.98 (0.93–1.03)</td>
<td>0.97 (0.95–0.99)</td>
<td>0.99 (0.94–1.04)</td>
</tr>
<tr>
<td>Degree of incidental detection at last follow-up\textsuperscript{c}</td>
<td>35.5%\textsuperscript{a}</td>
<td>46.0%</td>
<td>42.0%\textsuperscript{b}</td>
<td>—</td>
</tr>
</tbody>
</table>

AAA = abdominal aortic aneurysm.
\textsuperscript{a} Study at this follow up lacks differentiation between emergency surgery for ruptured and intact AAA.
\textsuperscript{b} Rate of repair for symptomatic intact AAAs not stratified for attenders vs. non-attenders in invited group. Symptomatic repairs thus excluded from calculation.
\textsuperscript{c} Incidental detection and repair rate. Ratio of intact AAA repair in control group vs. invited screened group, [Rate\textsubscript{Control}/Rate\textsubscript{Screened}]. Estimated from tabulated data in publications.
well.\textsuperscript{11,37,41} Falling AAA mortality is, however, not global,\textsuperscript{41} and exceptions to this falling trend are evident in countries not reporting falling smoking rates, such as Denmark\textsuperscript{42} and Austria.

During the last two decades surgical management of AAA has changed considerably, with an increased use of endovascular repair (EVAR), especially among elderly people, and an increased rate of elective AAA repair.\textsuperscript{11,15,43} Using the IMPACT model, Anjum et al.\textsuperscript{11} demonstrated that, second to falling smoking rates, the increased rate of elective AAA repairs may also significantly have contributed to the recent reduction in AAA mortality. Short-\textsuperscript{44,45} and long-term outcomes\textsuperscript{16} have improved significantly after AAA repair.

### Ongoing screening initiatives

Between 2009 and 2013, NAAASP rolled out in England, and is now the largest national population based screening program, inviting 300,000 65 year old men annually.\textsuperscript{46} Scotland, Wales, and Northern Ireland are implementing screening programs.\textsuperscript{1} Since 2007, when the Screening Abdominal Aortic Aneurysms Very Efficiently (SAAAVE) act was implemented in the USA, making 65 year old men newly enrolled in Medicare eligible for a free abdominal aortic ultrasound, there has been only a modest increase in abdominal aortic ultrasounds.\textsuperscript{47} Approximately 10\% undergained the reimbursed ultrasound, and no effects on AAA repair rates have been observed. Sweden has achieved >99\% national coverage of population based AAA screening between 2006 and 2013, targeting 65 year old men, and 5 year follow up data are available.\textsuperscript{48} Denmark is conducting a randomized AAA screening trial in a population of 50,000 men, recruited between 2008 and 2010.\textsuperscript{49} In Oslo, Norway, an observational AAA screening study is currently enrolling male subjects (Clinicaltrials.gov).

### Ethics, harm, and benefits

Not all screening detected AAAs will need repair, and only approximately half the repaired AAAs would have ruptured. This highlights the ethical dilemma that a small number of men will die from undergoing elective repair for a screening detected AAA that would never have ruptured. The risk of death from elective repair is estimated to 1 in 10,000 men invited to screening.\textsuperscript{50} The risk of death following repair also exists in incidentally detected AAAs, and it is higher than for screening detected AAAs, probably due to different timing of surgery, higher rates of comorbidity, and less standardized care.

In the final follow up in MASS,\textsuperscript{6} reduced all cause mortality was shown in the screened group, possibly a result of increased awareness and subsequent risk factor management of previously undetected cardiovascular morbidity. This effect on all cause mortality was, however, challenged in the latest systematic evidence review of AAA screening for the USPSTF.\textsuperscript{54} Also, the growing number of screening detected small AAAs under surveillance presents an appealing opportunity for medical treatment leading to a reduction of AAA growth; however, to date no drug has displayed a convincing effect on AAA growth, as reported in a comprehensive meta-analysis of 18 international studies.\textsuperscript{55} There is a multitude of ongoing studies addressing pharmacological modulation of AAA growth.

The issue of loss of quality of life (QoL), resulting from making an unknown disease known to a patient, is associated with conflicting evidence. Several studies on the effect of screening show a mild, transient reduction in QoL.\textsuperscript{1,6,56–58} A possible sustained impairment of QoL caused by screening significantly affects cost-effectiveness.\textsuperscript{59} Further research on the effects of surveillance management and how to inform patients is therefore indicated.

The small but clear risk of mortality following elective repair of a screening detected AAA highlights the paramount importance of balanced information when inviting people to screening. In a paper on screening ethics, it was evident that although an evidence based mortality benefit was a natural prerequisite, the ethics of AAA screening must fundamentally rest on the fact that a patient’s decision to submit to prophylactic healthcare is completely free and truly informed.\textsuperscript{60}

### Effect and cost-effectiveness

With falling prevalence rates in many countries, the rationale of AAA screening has rightly been called into question. Many model based, and in study based, cost-effectiveness analyses (CEA) of AAA screening have been conducted during the past decade (Table 2). It is worth noting that a Danish systematic review\textsuperscript{61} pointed to quality issues in some of the historical model studies, which should be considered when judging the combined results of cost-efficiency studies. Also, reliable modern data on observed rupture risks are lacking, since natural history studies are ethically impossible to perform. The studies used a variety of age groups and prevalence rates. However, the lifetime absolute risk reduction (ARR) from death from AAA calculated for each percent in AAA prevalence appears similar between the studies, with a median rate of 7.8 per 10,000.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Method</th>
<th>Prevalence (%)</th>
<th>Follow-up</th>
<th>Screening effect</th>
<th>Lys gained per 10,000 invited</th>
<th>ARR for AAA death per 10,000 invited</th>
<th>ICER Euros/QALY gained</th>
<th>ICER Euros/LY gained</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>QALYs gained</td>
<td>per Crude Adjusted</td>
<td>per Crude Adjusted</td>
<td></td>
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</tr>
<tr>
<td>One time, 65-year-old men</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Svensjö et al.50</td>
<td>Model</td>
<td>1.7</td>
<td>Lifetime (40 years)</td>
<td>109</td>
<td>64.1</td>
<td>142</td>
<td>83.5</td>
<td>16.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>13 years</td>
<td>57</td>
<td>33.5</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10 years</td>
<td>37</td>
<td>21.8</td>
<td>46</td>
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<tr>
<td>Søgaard et al.73</td>
<td>Model</td>
<td>3.3</td>
<td>Lifetime</td>
<td>1144</td>
<td>346.7</td>
<td>—</td>
<td>—</td>
<td>25</td>
</tr>
<tr>
<td>Spronk et al.75</td>
<td>Model</td>
<td>11.5</td>
<td>Netherlands Lifetime</td>
<td>759</td>
<td>66.0</td>
<td>970</td>
<td>84.3</td>
<td>85.9</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Norway Lifetime</td>
<td>449</td>
<td>39.0</td>
<td>570</td>
</tr>
<tr>
<td>Ehlers et al. 200976</td>
<td>Model</td>
<td>4.0</td>
<td>Lifetime</td>
<td>Not given</td>
<td>Not given</td>
<td>27</td>
<td>6.8</td>
<td>—</td>
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<tr>
<td>Montreuil et al.77</td>
<td>Model</td>
<td>4.2</td>
<td>Lifetime</td>
<td>190</td>
<td>45.2</td>
<td>—</td>
<td>53.5</td>
<td>12.7</td>
</tr>
<tr>
<td>Kim et al.78</td>
<td>Model</td>
<td>5.0</td>
<td>Lifetime (30 years)</td>
<td>200</td>
<td>40.0</td>
<td>250</td>
<td>50.0</td>
<td>Not given</td>
</tr>
<tr>
<td>Wanhainen et al.59</td>
<td>Model</td>
<td>5.5</td>
<td>Lifetime</td>
<td>—</td>
<td>—</td>
<td>200</td>
<td>36.4</td>
<td>234</td>
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<tr>
<td>Henriksson et al.79</td>
<td>Model</td>
<td>4.9d</td>
<td>Lifetime</td>
<td>200</td>
<td>40.8</td>
<td>250</td>
<td>51.0</td>
<td>Not given</td>
</tr>
<tr>
<td>Giardina et al.80</td>
<td>Model</td>
<td>2.9</td>
<td>Lifetime</td>
<td>110</td>
<td>37.9</td>
<td>140</td>
<td>48.3</td>
<td>32.4</td>
</tr>
<tr>
<td>Lindholt et al.22</td>
<td>In study</td>
<td>4.0</td>
<td>14 years</td>
<td>700</td>
<td>175.0</td>
<td>800</td>
<td>200.0</td>
<td>57.1</td>
</tr>
<tr>
<td>MASS, Thompson et al.81</td>
<td>In study</td>
<td>4.9</td>
<td>10 years</td>
<td>—</td>
<td>—</td>
<td>132</td>
<td>26.8</td>
<td>41.6</td>
</tr>
<tr>
<td>MASS, MASS-group22</td>
<td>In study</td>
<td>4.9</td>
<td>4 years</td>
<td>—</td>
<td>—</td>
<td>22</td>
<td>4.5</td>
<td>13.9</td>
</tr>
<tr>
<td>Median, of life-time analyses</td>
<td></td>
<td></td>
<td></td>
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</table>

Note. Model = using Markov model or Monte Carlo analysis; In study = in study CE evaluation/analysis; QALY = quality adjusted life year; LY = life-year; ARR = absolute risk reduction; ICER = incremental cost-efficiency ratio; ICERS reported before 2010 were updated to 2012 values using GDP deflator indices, and non-euro currencies were converted using mean exchange currency of 2012.

* Adjusted: calculated effect presented per 1% in AAA prevalence.
* QALYs gained per 10,000 estimated based on quality adjusted life-expectancy versus life years of life-expectancy in study.
* Based on reported ARR at 10 years in model, thus a higher value would be expected at lifetime analysis.
* Prevalence for 65yo men extrapolated to 65yo men from 65 to 75yo using random effects method, according to reported methods in publication.
* Based on reported numbers needed to screen to prevent one AAA-related death and adjusted for attendance rate of 61.6%.
invited for the most recent analyses, available. Similarly, the incremental cost-effectiveness ratio (ICER) in euros per quality adjusted life year (QALY) gained and life year (LY) gained display a median of €6622 and €5783, respectively; however, with wide ranges (€685–61,593) and (€3741–9860).

Applying the median ARR for each percent in prevalence to contemporary prevalence rates in 65 year old men from national population based screening programs from the UK and Sweden, an ARR of 10–15 per 10,000 invited could be expected. Specifically, at a prevalence of 1.7%, an ARR of 15.1 per 10,000 invited to screening after 13 years’ follow up (the equivalent of the maximum available follow up time in MASS) was estimated in the most recently published cost-effectiveness analysis linked to the national screening program in Sweden.50 In that study, AAA screening of 65 year old men was cost-effective down to a prevalence of 0.5%, and it was estimated that each prevented death from rupture saved 8.7 life years. At the various prevalence rates studied, all but one recent cost-effectiveness analysis estimated a lifetime cost per QALY gained with screening that was below the commonly referenced cost efficiency threshold value of €25,000 from the National Institute of Clinical Excellence (NICE) in the UK62 (Table 2).

A Cochrane systematic review63 estimated the ARR for death from breast cancer with mammography screening as five per 10,000 invited after 10 years of follow up, although much lower and higher ARR estimations have been reported. The corresponding ARR for death from colorectal cancer by fecal occult blood screening was estimated as 15 per 10,000 invited after 8–18 years of follow up in a Cochrane analysis.64 A European Prostate Cancer Screening study demonstrated an ARR of 7.1 per 10,000 invited after a median of 9 years’ follow-up.55 Thus, at contemporary prevalence rates of AAA, one time screening of 65 year old men appears to be a comparably effective preventive health measure.

The number of previously unknown AAAs detected at the time of screening is a major determinant of the ARR and cost-effectiveness of the screening system.50 An increased proportion of incidentally detected AAAs, for example by widespread CT scanning for the suspicion of other diagnoses, would effectively reduce the number of previously unknown AAAs detected at screening. This would reduce the prevalence of screening detected AAAs and subsequently reduce the cost-efficiency and clinical effect of screening (Fig. 2). The observed increasing longevity of elderly people, falling peri-operative mortality, and more elderly being eligible for preventive surgery could increase cost-efficiency of screening as well as life years saved.

In summary, a majority of cost-effectiveness analyses estimate AAA screening to be cost-effective, and this seems to be maintained at present. The observed falling prevalence is counterbalanced by lower peri-operative mortality and increased longevity, resulting in an unchanged low cost per QALY gained.

### Areas lacking information

**Women.** Women consistently display lower prevalence rates for AAA than men of the same age, with roughly one fourth to one sixth of that of men.56 In the UK Small Aneurysm Trial studying patients with AAA between 4.0 and 5.4 cm, women displayed a threefold increased rupture rate compared with men with equal diameter of AAA.67 A current review of AAA in women68 concluded that women undergo EVAR less often, mostly due to unfavorable neck anatomy, and seems to have a worse long-term outcome than in men. Women were also less likely to undergo repair if their AAA ruptured; mortality was higher after repair, and ruptures occurred later in life.

The only randomized screening trial including women, with a AAA prevalence of 1.3%, was the Chichester trial,2,69 showing no survival benefit for women. The number of women screened was only 3,052, however, and the study may therefore have been underpowered to detect a mortality benefit in the female population. A cost-effectiveness model analysis from 2006 demonstrated that screening women could be cost-effective due to higher rupture risk, and concluded that women should not be excluded from further evaluation for screening.70

In 2005, on the basis of available evidence, the United States Preventive Services Task Force (USPSTF) recommended against routine screening in women.71 Contrary to this, the Society for Vascular Surgery (SVS) in the USA recommended that women, 65 years or older, who have ever smoked or have a family history of AAA should be screened.
with ultrasound. Currently, there is no reported ongoing community based AAA screening of women in the world.

In a contemporary population based screening study of 5140 women, an AAA prevalence of only 0.4% was found among 70 year old women in Sweden. Smoking was strongly linked to AAA, with 95% of AAAs occurring among women who had ever smoked, comprising 44% of the cohort invited. It was concluded that population based screening in women could be ruled out. However, the AAA prevalence among smoking women (2.1%) was similar to that of all 65 year old men (1.7%), indicating this group as a possible target for selective screening (Fig. 3).

Sub-aneurysmal aortas and development of AAAs after a normal scan. A consequence of establishing screening programs is increased detection of small AAAs in need of surveillance. There is no consensus on the threshold diameter for continued surveillance after an aortic ultrasound. In the UK, NAAASP enters men with aortic diameters of 30 mm or more into surveillance, whereas in the USA and most of Sweden aortic diameters of 25 mm or more are offered surveillance. The value of re-screening was approached in a recent model study, which indicated only a limited effect on saved lives at a significantly increased cost. Extensive surveillance data from established national screening programs is, however, just now becoming available, and will provide a stronger foundation for cost-efficiency modeling of re-screening strategies in the future. In this setting, the natural history of sub-aneurysmal aortas (25–29 mm) is of increasing interest. In the final follow up of MASS the long-term protective effect of screening appeared to fall due to ruptures after >8 years among men initially screened normal (<30 mm). Approximately half of these ruptures occurred among those with a sub-aneurysmal aorta (25–29 mm) at the time of screening. Similar figures were derived from a large multicenter observational study on 1696 subjects with sub-aneurysmal aortas, where 60% had developed AAAs after 5 years. In a Swedish longitudinal cohort study, where 3268 men invited to screening at age 65 were re-invited and re-screened at age 70, 52.5% with sub-aneurysmal aortas had progressed to an AAA after 5 years. Regarding the clinical value of continued surveillance of these mostly small aneurysms now present in 70-year-old men, it should be remembered that this age was equivalent to the mean age at inclusion in the MASS study. Although no clear evidence exists regarding the clinical relevance of surveillance of persons with a sub-aneurysmal aorta, valuable data are accumulating from multiple ongoing screening programs. With over 50% progressing to a true AAA within 5 years, it would seem non-controversial to include this fairly small cohort (<2%) of men in post-screening surveillance programs.

CONCLUSION

Presently, there is a large body of evidence indicating that one time screening of 65 year old men is clinically relevant and cost-effective. Despite a falling prevalence, contemporary AAA screening in men still appears cost-effective, possibly by counterbalancing the low prevalence with improved surgical methods and improved long-term survival. Close monitoring of prevalence and the degree of incidental detection of AAAs in the population is mandated. If prevalence rates fall even further, general screening in men may prove futile, and alternative strategies with targeted screening of risk groups with higher prevalence, primarily smokers, should be evaluated. Furthermore, research on threshold values for ultrasound surveillance, the effect on quality of life of screening, and targeted screening of smoking women is indicated.

CONFLICT OF INTEREST
None.

FUNDING
None.

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