A
n abdominal aortic aneurysm (AAA) results from a weakening in a section of the aortic wall in the abdomen, which bulges because of pressure from blood flow to form an aneurysm.1 The aneurysm may grow and eventually rupture, causing death from hemorrhage.1 It is estimated that each year, 20,000 Canadians receive a diagnosis of AAA, and that between 2009 and 2013, about 1244 people died each year from an AAA.2,3 Because AAA is usually asymptomatic before rupture,1 screening could provide an opportunity to identify, monitor and treat to prevent a rupture.

Treatments for AAA include surgery to insert a graft inside the aorta or an endovascular procedure in which a graft is inserted through a groin incision and expanded in the aorta. Long-term outcomes are similar, although endovascular repair is less invasive and has lower perioperative mortality than surgical repair.4 Male sex is an important risk factor and AAA prevalence among men aged 65 to 80 years is four to six times higher than in women of the same age.5,6 Smoking is associated with formation, dilation and rupture of AAA.7,8 Other risk factors for the development of an AAA include advanced age9 and family history of AAA.10,11 Coronary artery disease, atherosclerosis, hypercholesterolemia and hypertension have weaker associations with AAA.8,12 Patients with diabetes appear less likely to develop AAA.13

Scope
The previous Canadian Task Force on Preventive Health Care guideline on AAA screening, released in 1991, concluded that evidence was insufficient to recommend for or against screening.14 Since that time, findings from four randomized controlled trials (RCTs)15–18 on screening for AAA have been published. This guideline presents recommendations on AAA screening in asymptomatic adults for primary care providers.

Methods
The task force is an independent panel of clinicians and methodologists that makes recommendations on primary and secondary prevention in primary care (see www.canadiantaskforce.ca).

KEY POINTS
• Pooled analyses from four population-based RCTs with men older than 65 years show that one-time screening with ultrasonography for AAA reduces the risk of aneurysm-related death, rupture and emergency repair.
• Screening leads to identification of aneurysms that would not dilate or rupture, and increases the likelihood of elective repair procedures for these patients.
• A weak recommendation in favour of screening suggests the importance of shared decision-making with the primary care provider and patient, with discussion of patient preferences for screening.
• The prevalence of AAA in screened populations has declined since the RCTs were conducted, reducing the absolute benefit of screening.
• Women have much lower rates of AAA than men, and there is no direct evidence that screening women has a positive impact on their health.
• Evidence on the impact of AAA screening on men older than 80 years of age is indirect, meaning any potential benefit is uncertain.

These recommendations were developed by a workgroup of five members of the task force, with scientific support from staff at the Public Health Agency of Canada.19 The recommendations are based on a systematic review, conducted by the Evidence Review and Synthesis Centre at McMaster University (Hamilton, Ontario), which updated the 2014 review by the US Preventive Services Task Force20 on outcomes of AAA screening with ultrasonography.21,22 Outcomes addressed by the systematic review included AAA-related and all-cause mortality, AAA rupture, 30-day mortality following emergency and elective procedures, and the impact of screening on frequency of emergency and elective procedures. The peer-reviewed literature search was conducted in MEDLINE, Embase, PubMed and CENTRAL from January 2013 to April 2015 with additional review of topic lists of relevant systematic reviews. A search for evidence on overdiagnosis was conducted in MED-
Box I: Grading of recommendations

Recommendations are graded according to the Grading of Recommendations Assessment, Development and Evaluation system (GRADE).28 GRADE offers two strengths of recommendation: strong and weak. The strength of recommendations is based on the balance between desirable and undesirable outcomes; the confidence in the magnitude of the estimates of effect of the intervention on outcomes; the confidence in values and preferences and their variability; and whether the intervention represents a wise use of resources.

Strong recommendations are those for which the task force is confident that the desirable effects of an intervention outweigh its undesirable effects (strong recommendation for an intervention) or that the undesirable effects of an intervention outweigh its desirable effects (strong recommendation against an intervention). A strong recommendation implies that most individuals will be best served by the recommended course of action and that the recommendation can be adopted in practice or as policy in most situations.

Strong recommendations are normally based on high-quality evidence (i.e., high confidence in the estimate of the effect of an intervention). Strong recommendations may recommend in favour of an intervention (when there is high confidence of benefit) or against an intervention (when there is high confidence of harm). However, there are five circumstances in which the task force may consider a strong recommendation based on low- or very low-quality evidence:28

- When low-quality evidence suggests benefit in a life-threatening situation (evidence regarding harms can be low or high)
- When low-quality evidence suggests benefit and high-quality evidence suggests harm or a very high cost
- When low-quality evidence suggests equivalence of two alternatives, but high-quality evidence of less harm for one of the competing alternatives
- When high-quality evidence suggests equivalence of two alternatives and low-quality evidence suggests harm in one alternative
- When high-quality evidence suggests modest benefits and low- or very low-quality evidence suggests possibility of catastrophic harm

Weak recommendations are those for which the desirable effects probably outweigh the undesirable effects (weak recommendation for an intervention) or undesirable effects probably outweigh the desirable effects (weak recommendation against an intervention), but appreciable uncertainty exists. Weak recommendations result when the balance between desirable and undesirable effects is small, the quality of evidence is lower, or there is more variability in the values and preferences of patients. Cases where the balance of cost and benefits is ambiguous, key stakeholders differ about the acceptability or feasibility of the implementation, and the effects on health equity are unclear are likely to result in a weak recommendation. A weak recommendation implies that most people would want the recommended course of action but that many would not. For clinicians, this means they must recognize that different choices will be appropriate for each individual, and they must help each person arrive at a management decision consistent with his or her values and preferences. Policy-making will require substantial debate and involvement of various stakeholders.

Evidence is graded as high, moderate, low or very low quality, based on how likely further research is to change the task force’s confidence in the estimate of effect.
Pooled results on outcomes of screening men aged 65 years and older for AAA with ultrasonography from the four RCTs at two points of follow-up — three to five years and 13 to 15 years — are reported in Table 2. Screening was associated with an absolute risk reduction of 1.3 fewer AAA-related deaths per 1000 men screened (0.8 to 1.6 fewer) at the three- to five-year follow-up and 3.2 fewer (0.6 to 6.0 fewer) at the 13- to 15-year follow-up.21,24 The number needed to screen to prevent one AAA-related death was 796 (95% confidence interval [CI] 621–1242) at three- to five-year follow-up and 311 (95% CI 199–1595) at 13 to 15 years.21,24

There was no difference in all-cause mortality at the three- to five-year follow-up (p = 0.10) (low-quality evidence), whereas at 13 to 15 years, there was a very modest reduction among those screened (moderate-quality evidence).21,24 Screening resulted in reductions in AAA rupture, emergency AAA procedures and death within 30 days of an AAA procedure21,24,25 (Table 2). Screening also resulted in significant increases in the overall risk of having a procedure to repair an AAA and the likelihood of undergoing an elective AAA repair among those screened.21,24

In stratified analysis, the difference between the screened and control group for 30-day mortality following an elective AAA procedure was minimal at three to five years of follow-up (moderate-quality evidence), with no difference at 13 to 15 years (low-quality evidence).20,23 For emergency AAA procedures, there was no difference in 30-day mortality between the screened and control groups at either follow-up period (low-quality evidence).20,25

Four studies were identified that evaluated the effect of AAA screening on quality of life (very low-quality evidence) among men aged 65 years and older.22 Three observational studies used standardized measures for quality of life and did not find statistically significant differences between patients who screened positively compared with the control group.22 Postscreening data from the Multicentre Aneurysm Screening Study (MASS) trial also reported no difference in quality-of-life measures between screen-positive and control groups.22

With regard to overdiagnosis (identification of an AAA that would not have ruptured), an analysis of low-quality evidence from the 13-year follow-up of the MASS trial estimated the rate in the screen-positive group at 45% (95% CI 42%–47%).22 The authors calculated that 17.6 (95% CI 15.0–20.2) patients would be overdiagnosed for every 1000 screened.39

Recent population-based screening studies of men older than 65 years of age conducted in England40 and Sweden41 show that prevalence of AAA is declining, with estimates ranging from 1.5% to 1.7%. The rates of AAA among the men in the RCTs ranged from 3.9% to 7.2%.15–18 The reduced prevalence of AAA in recent years has been attributed to changes in smoking behaviour, as well as improved management of hypertension and hypercholesterolemia.40,41

### Table 1: Randomized controlled trials on outcomes of screening men aged 65 years and older for AAA with ultrasonography

<table>
<thead>
<tr>
<th>Study</th>
<th>Location</th>
<th>Sample size</th>
<th>Intervention/control</th>
<th>Mean length of follow-up, yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multicentre Aneurysm Screening Study (MASS)17,29–31</td>
<td>Four sites in England</td>
<td>n = 67 700</td>
<td>Intervention, n = 33 883; Control, n = 33 887</td>
<td>13.1</td>
</tr>
<tr>
<td>Chichester6,18,22,33</td>
<td>England</td>
<td>n = 6433</td>
<td>Intervention, n = 3228; Control, n = 3205</td>
<td>15</td>
</tr>
<tr>
<td>Viborg35,36,37</td>
<td>Denmark</td>
<td>n = 12 639</td>
<td>Intervention, n = 6333; Control, n = 6306</td>
<td>14</td>
</tr>
<tr>
<td>Western Australia35,34,38</td>
<td>Australia</td>
<td>n = 38 704</td>
<td>Intervention, n = 19 249; Control, n = 19 231</td>
<td>12.8</td>
</tr>
</tbody>
</table>

Note: AAA = abdominal aortic aneurysm.
Table 2 (part 1 of 2): Outcomes of one-time screening for AAA using ultrasonography for men aged 65 years and older*

<table>
<thead>
<tr>
<th>Outcome and follow-up period</th>
<th>No. of studies</th>
<th>Cases/received procedure screened patients (%)</th>
<th>Cases/received procedure control patients (%)</th>
<th>Risk ratio (95% CI)</th>
<th>Absolute per 1000</th>
<th>Absolute risk reduction, %</th>
<th>Absolute risk increase, %</th>
<th>Number needed to screen (95% CI)</th>
<th>Quality of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA-related mortality 3–5 yr22</td>
<td>4</td>
<td>102/62,729 (0.16)</td>
<td>182/62,847 (0.29)</td>
<td>0.57 (0.44–0.72)</td>
<td>1.3 fewer</td>
<td>from 0.8 fewer to 1.6 fewer</td>
<td>0.13</td>
<td>796 (621–1242)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>AAA-related mortality 13–15 yr22,24</td>
<td>4</td>
<td>380/62,460 (0.61)</td>
<td>588/62,469 (0.94)</td>
<td>0.66 (0.47–0.93)</td>
<td>3.2 fewer</td>
<td>from 0.6 fewer to 5.0 fewer</td>
<td>0.32</td>
<td>311 (199–1595)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>All-cause mortality 3–5 yr22</td>
<td>4</td>
<td>7453/62,729 (11.9)</td>
<td>7953/62,847 (12.7)</td>
<td>0.95 (0.88–1.02)</td>
<td>7.0 fewer</td>
<td>from 15.7 fewer to 2.5 more</td>
<td>NS</td>
<td>–</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>All-cause mortality 13–15 yr22,24</td>
<td>4</td>
<td>28,474/62,460 (45.6)</td>
<td>28,899/62,469 (46.3)</td>
<td>0.99 (0.98–1.00)</td>
<td>6.1 fewer</td>
<td>from 0.7 fewer to 11.4 fewer</td>
<td>0.61</td>
<td>164 (88–1441)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Rupture of an AAA 3–5 yr22</td>
<td>4</td>
<td>117/62,729 (0.19)</td>
<td>218/62,847 (0.35)</td>
<td>0.52 (0.35–0.79)</td>
<td>1.6 fewer</td>
<td>from 0.7 fewer to 2.3 fewer</td>
<td>0.16</td>
<td>606 (442–1387)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Rupture of an AAA 13–15 yr22,24</td>
<td>4</td>
<td>415/62,460 (0.66)</td>
<td>674/62,469 (1.1)</td>
<td>0.65 (0.51–0.82)</td>
<td>3.8 fewer</td>
<td>from 1.9 fewer to 5.2 fewer</td>
<td>0.38</td>
<td>264 (191–515)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>AAA procedures 3–5 yr22</td>
<td>4</td>
<td>554/62,729 (0.88)</td>
<td>252/62,847 (0.4)</td>
<td>2.16 (1.82–2.57)</td>
<td>4.7 more</td>
<td>from 3.3 more to 6.3 more</td>
<td>0.47</td>
<td>215 (159–305)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>AAA procedures 13–15 yr22,24</td>
<td>4</td>
<td>1408/62,460 (2.3)</td>
<td>1029/62,469 (1.6)</td>
<td>1.35 (1.17–1.57)</td>
<td>5.9 more</td>
<td>from 2.8 more to 9.4 more</td>
<td>0.58</td>
<td>171 (107–358)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Elective procedures 3–5 yr22</td>
<td>4</td>
<td>505/62,729 (0.81)</td>
<td>162/62,847 (0.26)</td>
<td>3.25 (2.13–4.96)</td>
<td>5.8 more</td>
<td>from 2.9 more to 10.2 more</td>
<td>0.58</td>
<td>172 (98–342)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Elective procedures 13–15 yr22,24</td>
<td>4</td>
<td>1266/62,460 (2.0)</td>
<td>754/62,469 (1.2)</td>
<td>1.83 (1.29–2.59)</td>
<td>10.0 more</td>
<td>from 3.6 to 19.2 more</td>
<td>1.00</td>
<td>100 (52–281)</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Emergency procedures 3–5 yr22,25</td>
<td>4</td>
<td>44/62,729 (0.07)</td>
<td>90/62,847 (0.14)</td>
<td>0.50 (0.29–0.86)</td>
<td>0.7 fewer</td>
<td>from 0.2 fewer to 1.0 fewer</td>
<td>0.07</td>
<td>–</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
<tr>
<td>Emergency procedures 13–15 yr24,25</td>
<td>4</td>
<td>142/62,460 (0.23)</td>
<td>275/62,469 (0.44)</td>
<td>0.52 (0.42–0.63)</td>
<td>2.1 fewer</td>
<td>from 1.6 fewer to 2.5 fewer</td>
<td>0.21</td>
<td>–</td>
<td>⊕⊕⊕⊕ ⊕ MODERATE†</td>
</tr>
</tbody>
</table>
Patient values and preferences

In the focus group and survey of men and women aged 65 to 80 years (n = 19) to obtain patient preferences, participants were informed of the potential benefits and risks of AAA screening, including overdiagnosis. Most participants would choose to be screened if they felt that risk factors for an AAA applied to them, but there was less agreement on encouraging someone older than 80 years to be screened.26

Resource use

The systematic review22 reported cost-effectiveness of screening for AAA from findings of two systematic reviews,44,45 an RCT33 and three modelling studies.46–48 AAA screening was cost effective, with an incremental cost-efficiency ratio of less than US$30,000 per quality-adjusted life-year gained.22 A recent report on outcomes of the Swedish nationwide screening program concluded that screening for AAA remains cost effective, despite declining prevalence and a shift to more expensive procedures.49

Feasibility, acceptability, cost and equity

Most stakeholder respondents (n = 5) to the FACE survey from health-related organizations indicated that the recommendations presented are feasible, acceptable, affordable, and would not negatively affect health equity. Stakeholders also reported a high intent to implement the recommendations (Appendix 2).

Rationale

Men aged 65 to 80 years

Moderate-quality evidence indicated that screening men aged 65 to 80 years will yield modest reductions in AAA-related mortality, AAA rupture and rates of emergency interventions.22,24 Although some elective procedures will result from identification of an AAA that might never have ruptured, as a result of overdiagnosis, in the judgment of the task force, this possible harm is outweighed by the reduced risk of AAA-related mortality, rupture and emergency procedures with screening.22,24 In balancing the overall benefits and harms of screening for men older than 80 years, the benefits

<table>
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<tr>
<th>Outcome and follow-up period</th>
<th>No. of studies</th>
<th>Cases/received procedure screened patients (%)</th>
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<th>Risk ratio (95% CI)</th>
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<th>Absolute risk reduction, %</th>
<th>Absolute risk increase, %</th>
<th>Number needed to screen (95% CI)</th>
<th>Quality of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-day mortality, after any AAA procedures 3–5 yr22,25</td>
<td>3</td>
<td>29/501 (5.8)</td>
<td>41/221 (18.6)</td>
<td>0.31 (0.20–0.48)</td>
<td>128.0 fewer (from 95.7 fewer to 149.0 fewer)</td>
<td>12.83</td>
<td>–</td>
<td>8 (7–10)</td>
<td>⊕⊕⊕ O MODERATE†</td>
</tr>
<tr>
<td>30-day mortality, after any AAA procedures 13–15 yr24,25</td>
<td>3</td>
<td>92/1,299 (7.1)</td>
<td>119/941 (12.6)</td>
<td>0.55 (0.39–0.80)</td>
<td>56.3 fewer (from 25.6 fewer to 77.7 fewer)</td>
<td>5.63</td>
<td>–</td>
<td>18 (13–39)</td>
<td>⊕⊕⊕ O MODERATE†</td>
</tr>
</tbody>
</table>

Note: AAA = abdominal aortic aneurysm, CI = confidence interval, NS = not significant.

* The estimated absolute risk reduction/increase is from pooled results of the trials on AAA screening. The prevalence of AAA in screened populations of men aged 65 years and older at the time of the trials was 3.9% to 7.2%, with more recent population-based estimates of prevalence in countries similar to Canada ranging from 1.5% to 1.7%, reducing the benefit of screening.

† Downgraded to moderate owing to serious risk of bias.

‡ Downgraded to low owing to serious risk of bias and imprecision.
likely do not outweigh the harms. Therefore, the task force recommended against screening men in this age group.

The recommendation is weak, because uncertainty remains owing to the low quality of evidence on the size of the effect of screening men older than 80 years. A weak recommendation suggests primary care providers should discuss patient preferences regarding screening with healthy men older than 80 years of age for whom an elective procedure to repair an AAA would pose less risk.

Women

Very low-quality evidence from an underpowered RCT reported that screening women for AAA does not result in improved health outcomes. Even in the era when AAA was more common, women had lower rates of AAA, and when AAA occurred, it tended to happen later in their lives than for men; any potential for benefit is very small. Women also have greater risk of death following an AAA procedure. In the judgment of the task force, when considering the balance between benefits and harms, there is very low-quality evidence suggesting that women do not benefit from screening, and death from an AAA procedure is a potential harm. Therefore, the recommendation is against screening women for AAA.

The recommendation is strong, as risk of developing an AAA is much lower for women, but AAA screening would harm some women and consume resources that could otherwise be used for interventions with demonstrated effectiveness.

Considerations for implementation

Male sex, family history and increasing age have all been associated with an increased risk of AAA. A review of observational studies on the risk of AAA among smokers indicated that smokers have a higher risk of AAA than never smokers; current smokers have a higher risk of developing AAA than former smokers; and those who smoke more than 20 cigarettes a day have a higher risk of AAA than those who smoke less. In relation to growth and rupture of an AAA, a meta-analysis conducted by the RESCAN collaboration found that current smoking has a modest impact on growth of an AAA and doubles the risk of rupture. Clinicians could ask about smoking history during a discussion...
on screening for AAA, as patients who have ever smoked may be more interested in being screened.

There is some evidence that cardiac failure, renal impairment, chronic obstructive pulmonary disease, peripheral vascular disease, cerebrovascular disease, ischemic heart disease and diabetes are associated with greater risk of death following elective repair of an AAA. It is important that men aged 65 to 80 years with chronic health conditions such as these are aware of their particular risks from elective repair of an AAA before they decide to be screened. In contrast, men older than 80 years who do not have these conditions may choose to be screened. Increasing age and female sex are also associated with increased risk of death following AAA repair.

Ultrasonography was used to screen for AAA in the RCTs because of its relative ease of use and known sensitivity and specificity. A Canadian observational study indicated that, with training, providing AAA screening in a family physician setting was accurate and feasible.

Endovascular repair is less invasive than conventional surgery and has lower perioperative mortality, although long-term outcomes are similar for the two methods. No randomized trials have evaluated the benefits of screen-directed endovascular repair compared with no screening. However, in the judgment of the task force, it is reasonable to assume that benefits associated with screen-directed repair are comparable with conventional techniques. Although the less invasive nature of endovascular repair might seem to encourage screening strategies that intervene at an earlier stage (e.g., smaller AAA size) as compared with conventional surgery, this practice is not supported by trial data. Given the less invasive nature of endovascular procedures and lower rates of perioperative death, patients may be more inclined to choose screening where this type of repair is available.

Suggested performance measures for implementation

Suggested performance measures for implementation of the recommendations include the proportion of men aged 65 to 80 years with whom primary care providers discuss screening for AAA, the number who are screened and the outcomes of screening.

Other guidelines

The US Prevention Services Task Force recommends that men aged 65 to 75 years who have ever smoked be screened for AAA with ultrasonography. The Canadian Society of Vascular Surgery’s guideline recommends that men aged 65 to 75 years be screened. Table 3 highlights recommendations from other guidelines.

Gaps in knowledge

Further work is required to assess whether screening has a differential impact on health outcomes on subgroups, including those who have ever smoked and adults with a family history of AAA, and whether there is value in rescreening all patients or rescreening specific sets within the population, such as by race or ethnicity. Future studies should also monitor the epidemiology of AAA as age-based screening may have less of a positive impact if the prevalence of AAA continues to decline in the general population. Ultimately, a more targeted approach to screening could be required.

Conclusion

Based on the systematic review of the evidence, the task force has revised its recommendation on screening for AAA since its last review in 1991. Pooled results of four population-based RCTs provide evidence that screening men aged 65 to 80 years has a sufficiently positive impact on reducing mortality, rupture and emergency procedures, which outweigh the risk of identification and unnecessary elective procedures of AAA that might never have ruptured.

References


