

# Endovascular stent-grafts for the treatment of abdominal aortic aneurysms

Technology appraisal guidance

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Commissioners and providers have a responsibility to promote an environmentally sustainable health and care system and should assess and reduce the environmental impact of implementing NICE recommendations wherever possible.

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## 1 Guidance

This guidance refers to the use of endovascular stent-grafts or open surgical repair only for the treatment of infra-renal abdominal aortic aneurysms. This guidance should be read in conjunction with 'Stent-graft placement in abdominal aortic aneurysm' (NICE interventional procedure guidance 163).

- 1.1 Endovascular stent-grafts are recommended as a treatment option for patients with unruptured infra-renal abdominal aortic aneurysms, for whom surgical intervention (open surgical repair or endovascular aneurysm repair) is considered appropriate.
- 1.2 The decision on whether endovascular aneurysm repair is preferred over open surgical repair should be made jointly by the patient and their clinician after assessment of a number of factors including:
  - aneurysm size and morphology
  - patient age, general life expectancy and fitness for open surgery
  - the short- and long-term benefits and risks of the procedures including aneurysm-related mortality and operative mortality.
- 1.3 Endovascular aneurysm repair should only be performed in specialist centres by clinical teams experienced in the management of abdominal aortic aneurysms. The teams should have appropriate expertise in all aspects of patient assessment and the use of endovascular aortic stent-grafts.
- 1.4 Endovascular aortic stent-grafts are not recommended for patients with ruptured aneurysms except in the context of research. Given the difficulties of conducting randomised controlled trials, it is recommended that data should be collected through existing registries to enable further research.

## 2 Clinical need and practice

- 2.1 Aortic aneurysms develop when the wall of the aorta weakens, causing it to bulge and form a balloon-like projection. This leads to further stretching of the wall of the aorta and an increase in tension. Eventually the wall may rupture, leading to massive internal bleeding. Aneurysms are often a result of atherosclerosis and most occur in the abdominal section of the aorta. An abdominal aortic aneurysm (AAA) is defined as an enlargement of the aorta of at least 1.5 times its normal diameter or greater than 3 cm diameter in total. Most AAAs occur in the lower part of the abdominal aorta, below the kidney (infra-renal). The main risk factors for AAA include increasing age, high blood pressure, smoking and family history of AAA. AAAs are about three times more common in men than in women.
- 2.2 Most AAAs are detected by chance during clinical investigation (for example, ultrasound or X-ray) for other conditions. Because most AAAs are asymptomatic, it is difficult to estimate their prevalence, but screening studies in the UK have estimated a prevalence of 1.3–12.7% depending on the age group studied and the definition of AAA. The incidence of symptomatic AAA in men is approximately 25 per 100,000 at age 50, increasing to 78 per 100,000 in those older than 70 years. The implementation of a national screening programme for AAA is under way with the first centres expected to start screening by March 2009. The remaining centres will be managed in a phased roll-out over the next 5 years.
- 2.3 Symptoms that can occur as an aneurysm enlarges include a pulsating sensation in the abdomen, back pain and abdominal pain that may spread to the back. Patients with a symptomatic AAA need rapid medical attention. Among patients with a ruptured AAA the mortality rate is about 80%; even when they undergo emergency surgery, only about half survive beyond 30 days. The risk of rupture increases with the size of the aneurysm, and those aneurysms larger than 6 cm in diameter have an annual risk of rupture of 25%. Several studies indicate that without surgery the 5-year survival rate for patients with aneurysms larger than 5 cm is about 20%.
- 2.4 Patients with an AAA can be treated by surgical repair to prevent rupture. Conventional (open) surgical repair (OSR) involves making a large incision in the abdomen and inserting a prosthetic graft to replace the damaged section of the

aorta. OSR can also be performed laparoscopically, either by hand-assisted laparoscopic surgery or totally laparoscopic surgery. Endovascular aneurysm repair (EVAR) is a minimally invasive technique that involves a stent-graft being inserted through a small incision in the femoral artery in the groin. It is carried to the site of the aneurysm using catheters and guide wires and placed in position under X-ray guidance. Once in position, the stent-graft is anchored to the wall of the aorta using a variety of fixing mechanisms.

2.5 Potential advantages of EVAR over OSR include reduced time under general anaesthesia, elimination of the pain and trauma associated with major abdominal surgery, reduced length of stay in the hospital and intensive care unit (ICU), and reduced blood loss. Potential disadvantages include the development of endovascular leaks (endoleaks), which occur when blood continues to flow through the aneurysm because the graft does not seal completely (type I endoleak) or because of backfilling of the aneurysm from other small vessels in the aneurysm wall (type II endoleak). Patients who have had OSR do not require any special follow-up, but patients who have undergone EVAR may require computed tomography (CT) or ultrasound scans to check for the presence of late-occurring endoleaks. In addition, if EVAR is unsuccessful or complications arise during the procedure, conversion to OSR may be necessary even in patients initially considered unfit for open surgery.

2.6 In current UK clinical practice, elective surgery is generally recommended for patients with aneurysms larger than 5.5 cm in diameter and with aneurysms larger than 4.5 cm in diameter that have increased by more than 0.5 cm in the past 6 months. Current guidelines from the Vascular Society and the National Screening Committee recommend that patients with symptomatic aneurysms of less than 4.5 cm in diameter should be followed up with ultrasonography every 6 months, and aneurysms of 4.5–5.5 cm in diameter should be followed up every 3 or 6 months.

### 3 The technologies

- 3.1 The stent-graft typically comprises a self-expanding nickel-titanium (nitinol) stent attached to a woven polyester fabric graft. Bifurcated grafts are modular with multiple segments: a proximal tube, a flow divider, a full-length ipsilateral iliac limb and a short contralateral stump for attachment of the second iliac limb. The stent-grafts are attached to the aortic wall by metallic wires, hooks and anchors. Additional modular components include aortic and iliac extender cuffs, which are used for the treatment of type I endoleaks. The main types of endovascular stent-grafts are: aortic tube grafts (no longer used in the UK), aorto-uni-iliac grafts and aorto-bi-iliac (bifurcated) grafts (the latter are most commonly used in the UK).
- 3.2 Five stent-grafts have been included in this appraisal. These are the Talent stent-graft (Medtronic), Excluder AAA endoprosthesis (WL Gore), Aorfix AAA stent-graft (Lombard Medical), Zenith AAA endovascular graft (Cook Medical) and Endologix Powerlink Systems (Le Maitre). All have been granted Conformité Européene (CE) marking for use within European Union (EU) countries. The indications for use for each of the stent-grafts vary; these are given in the instructions for each device.
- 3.3 The individual endovascular stent-grafts made by different companies each have a different cost. Costs are further complicated by the fact that patients who are fitted with the same manufacturer's device may require different numbers of components. The manufacturers who produce the devices also offer different pricing structures; for example, some charge a price per patient regardless of the number of components needed, whereas others base their price on the number of parts required.
- 3.4 Four of the manufacturers stated that their list prices were commercial-in-confidence. Lombard Medical stated that the price of their Aorfix AAA stent-graft was £5000, which was a fixed price per patient irrespective of the number of components used. A price to the NHS of £5000 was supported by limited sample data for 2007/08 collected by the NHS Purchasing and Supply Agency from some NHS organisations in England. These data confirmed that the average price of an endovascular stent-graft, irrespective of the number of components used, was £5000.

## 4 Evidence and interpretation

The Appraisal Committee ([appendix A](#)) considered evidence from a number of sources ([appendix B](#)).

### 4.1 Clinical effectiveness

- 4.1.1 The Assessment Group identified studies of adult patients with asymptomatic or symptomatic, ruptured or unruptured infra-renal AAAs that compared EVAR using stent-grafts with conventional OSR and/or with non-surgical treatment (sometimes referred to as watchful waiting). In their systematic review, the Assessment Group included randomised controlled trials (RCTs) and large registries relevant to UK practice. The registries included were the National Vascular Database (NVD) for open surgery, the Registry of Endovascular Treatment of Abdominal Aortic Aneurysms (RETA) and the European Collaborators on Stent-Graft Techniques for Abdominal Aortic Repair (EUROSTAR). Where appropriate, the Assessment Group used meta-analysis to estimate a summary measure of treatment effect on relevant outcomes based on intention-to-treat (ITT) analyses.
- 4.1.2 To identify criteria for selecting patients appropriate for EVAR, the Assessment Group also reviewed studies that modelled a large range of risk factors. Risk-modelling studies were specific to AAA, focused on risk of mortality following EVAR, and used appropriate statistical modelling techniques. Studies were required to be based on a trial, registry or a series of at least 500 patients from developed countries of relevance to UK practice.

#### EVAR versus OSR in patients with unruptured aneurysms

- 4.1.3 Four RCTs compared EVAR with OSR in patients with unruptured AAA (EVAR 1, n = 1082; DREAM, n = 351; Cuypers and co-workers, n = 76; and Soulez and co-workers, n = 40). Most patients in the RCTs were men, reflecting the disease profile, and the average age of patients ranged from late 60s to mid-70s. The four RCTs were relatively homogeneous in terms of average aneurysm diameter (6.5 cm, 6.0 cm, 5.4 cm and 5.2 cm, respectively).
- 4.1.4 All four RCTs reported 30-day mortality. The pooled estimate of effect suggested a significantly lower rate of 30-day mortality in the EVAR group:

pooled odds ratio (OR) 0.35 (95% confidence interval [CI] 0.19 to 0.63). The 30-day mortality rate of 2.3% in the EUROSTAR registry was comparable with the 1.7% in the EVAR arm of EVAR 1. In the UK NVD crude operative mortality following OSR of unruptured aneurysms was 6.8%, compared with 4.7% in the OSR arm of EVAR 1.

- 4.1.5 EVAR 1 and DREAM provided information on all-cause mortality at follow-up (at 4 years and 2 years, respectively). Both RCTs reported no significant difference in medium-term mortality (at 42 and 35 months, respectively) in patients treated with EVAR compared with OSR. A pooled analysis of the two trials confirmed that there was no statistically significant difference between EVAR and OSR for all-cause mortality at medium-term follow-up.
- 4.1.6 The four RCTs provided limited information on rupture as a separate outcome. The limited data available suggest that rupture may be more of an issue following EVAR than following OSR. The cumulative rate of rupture in patients from EUROSTAR was 3.1% over 7 years.
- 4.1.7 Only the EVAR 1 and Soulez and co-workers trials reported endoleak as an outcome. Across these RCTs, some form of endoleak occurred at varying frequencies (up to approximately 20%) following EVAR. Type II endoleaks were most common, followed by type I. The cumulative rate of endoleaks in patients from the EUROSTAR registry was higher (32.5%).
- 4.1.8 Only EVAR 1 reported on device migration following EVAR. In the trial, 12 of 529 (2.3%) patients experienced device migration during follow-up, of whom seven (1%) required re-intervention.
- 4.1.9 The EVAR 1 and DREAM trials compared overall re-intervention rates between patients treated with EVAR and OSR. In DREAM, the risk of re-intervention was significantly higher in the EVAR group for the first 9 months (hazard ratio 2.9; 95% CI 1.1 to 6.2,  $p = 0.03$ ) but the groups were not significantly different thereafter (hazard ratio 1.1; 95% CI 0.1 to 9.3,  $p = 0.95$ ). At the medium-term follow-up in EVAR 1, the hazard ratio for re-intervention was 2.7 (95% CI 1.8 to 4.1) indicating a higher risk in the EVAR group. The 4-year point estimates for re-intervention in this trial were 20% for the EVAR group compared with 6% for the OSR group. The cumulative rate of re-intervention in the EUROSTAR registry was similar to the 4-year point estimate for the EVAR group in EVAR 1.

- 4.1.10 Only the trial by Cuypers and co-workers reported cardiac events: three (5%) in the EVAR group and two (11%) in the OSR group.
- 4.1.11 All four RCTs reported some details of health-related quality of life (HRQoL). All used the Medical Outcomes Study short form 36 (SF-36) questionnaire, but different components were reported, making it difficult to compare results across studies. Overall, data from these trials suggested that there may be a short-term quality-of-life advantage for EVAR patients compared with those who have OSR. Longer-term quality-of-life data tended to favour OSR.

### EVAR versus non-surgical management (patients with unruptured aneurysms considered unfit for OSR)

- 4.1.12 The Assessment Group identified one published RCT (EVAR 2, n = 338) that compared EVAR and non-surgical management in patients judged to be unfit for OSR. The Assessment Group considered the trial to be of high quality. The primary endpoint was all-cause mortality and secondary endpoints were aneurysm-related mortality, HRQoL, postoperative complications and hospital costs. The trial found no differences in AAA-related and all-cause mortality outcomes between groups at medium term. However, this finding cannot be taken as definitive because substantial numbers of patients randomised to non-surgical management crossed over to receive surgical repair of their aneurysm.

### Assessment of risk factors for adverse outcomes following EVAR

- 4.1.13 The Assessment Group identified 32 studies investigating specific risk factors for adverse outcomes after EVAR. The Assessment Group stated that the studies did not provide definitive evidence but age, gender, renal impairment, fitness, American Society of Anesthesiologists (ASA) score and aneurysm size may be predictive of lower 30-day survival. There may be an association between fitness for the open procedure, aneurysm size and device type and aneurysm-related mortality. Pulmonary status, renal impairment, ASA score and aneurysm size might adversely affect all-cause mortality. The Assessment Group did not find any consistent risk factors for re-intervention.

### Summary

- 4.1.14 Compared with OSR, EVAR reduced operative mortality (OR 0.35; 95% CI 0.19 to 0.73) and aneurysm-related mortality over the medium term (OR 0.49; 95%

CI 0.29 to 0.83) but offered no significant difference in all-cause mortality at medium term. EVAR was associated with an increased rate of complications and re-interventions. There was limited RCT evidence comparing EVAR with non-surgical management in patients unfit for OSR. Although the EVAR 2 trial found no differences in mortality outcomes between groups this finding should not be taken as definitive.

## 4.2 Cost effectiveness

### Published literature

- 4.2.1 The Assessment Group identified five economic evaluations that considered EVAR for patients with unruptured aneurysms, who needed surgery and were considered fit for open surgery. All five were cost-utility analyses. Two were based on EVAR programmes in the USA (Patel and co-workers and Bosch and co-workers), two were based on EVAR programmes in the UK (Epstein and co-workers and Michaels and co-workers) and one was based on an EVAR programme in the Netherlands (Prinssen and co-workers). These economic evaluations showed conflicting results. Patel and co-workers estimated \$9905 per quality-adjusted life year (QALY) gained and Bosch and co-workers estimated \$22,836 per QALY gained, whereas others (Epstein and co-workers and Prinssen and co-workers) estimated £110,000 per QALY gained. Michaels and co-workers found that EVAR was dominated by OSR.
- 4.2.2 The economic evaluation by Michaels and co-workers also considered EVAR for patients with unruptured aneurysms who were considered unfit for OSR. This was based on effectiveness and resource data taken from EVAR 1, DREAM and a systematic review of the literature. This evaluation resulted in an ICER of £8579 per QALY gained for EVAR in patients who were unfit for OSR.
- 4.2.3 The EVAR 2 trial investigated whether EVAR improved survival compared with no intervention in patients who were considered unfit for OSR. The Assessment Group stated that, although it was not explicitly a cost-effectiveness study, it had been included in their cost-effectiveness review because the study reported life expectancy and costs, and there have been no other cost-effectiveness analyses published in the light of the results of this trial. The study found that EVAR did not improve HRQoL over the period, had a high 30-day operative mortality rate, had no 4-year survival benefit, and had considerably higher costs

than the no-intervention arm. Therefore, in the patient group considered (approximately 76 years of age with AAA of roughly 6.5 cm in diameter), it appeared that EVAR may be dominated by the no-intervention arm (that is, EVAR has higher costs and worse outcomes).

## Manufacturer's economic model

- 4.2.4 Medtronic conducted a cost-utility analysis comparing EVAR with OSR in patients with an unruptured infra-renal AAA of at least 5.5 cm in diameter who were considered fit for open surgery. The average age of the population was 70 years and 90% of the patients were men.
- 4.2.5 Medtronic developed a two-stage model to estimate the lifetime costs and QALYs for EVAR and OSR in this patient population. The model comprised a decision tree for the first 30 days after surgery and then a Markov model from 30 days after surgery until death. At the end of the first 30 days, patients in the EVAR arm entered one of four states: successful EVAR with no complications; EVAR with complications; conversion to open surgery; or death. Patients in the OSR arm entered one of three states: OSR with no complications; OSR with complications; or death.
- 4.2.6 The effectiveness data used in the model, utility scores for health states and resource use data, were largely drawn from EVAR 1 for OSR and supplemented with additional commercial-in-confidence data. Utility scores for health states were taken directly from EVAR 1. These indicated that in the first 3 months after surgery, patients in the OSR arm had a slightly lower utility (0.67) than patients in the EVAR arm (0.73). From 24 months onwards it was assumed that utility was equal in both arms (although it was age dependent). Disutility scores for the systemic complications were drawn from several sources.
- 4.2.7 Data on mortality were obtained from a re-analysis of data from the EVAR 1 trial stratified by Customised Probability Index score for a 4-year time period and split by AAA-related mortality and all-cause mortality. AAA-related mortality was defined as deaths within 30 days of surgery for AAA as well as deaths for which the underlying cause was attributable to ICD codes I713-19, 'all-cause mortality'. This term captured all causes of death and, if randomisation had been properly conducted, any difference should only have occurred with respect to mortality associated with the procedure.

- 4.2.8 For the base-case analysis from the Medtronic model, the ICER at 30 years for this patient group, applying all-cause mortality rates, was £15,681 per QALY gained. The ICER was lower when the AAA-related mortality rate was applied with an ICER of £11,339 per QALY gained. Secondary analysis demonstrated that, when extreme data points on length of stay were removed, the base-case ICER was £12,526 per QALY gained when applying all-cause mortality rates.
- 4.2.9 Medtronic conducted univariate sensitivity analyses for all the parameters in the model, using the values for the lower and upper confidence limits of each parameter. The manufacturer found that the ICER was most sensitive to the short-term relative risk of operative mortality.

### Assessment Group model

- 4.2.10 The Assessment Group's economic evaluation was divided into two parts. The first part compared the cost effectiveness of EVAR with OSR in patients with large unruptured aneurysms (at least 5.5 cm in diameter) considered fit for OSR. This analysis assumed that the decision to operate had already been taken. The second part of the Assessment Group's economic evaluation estimated the cost effectiveness of treatment strategies that differed in when and how the aneurysm repair for unruptured aneurysms should be carried out. In this second part, the Assessment Group compared surgery (EVAR or OSR) with no surgery or watchful waiting as alternative treatment strategies.
- 4.2.11 In the analyses for both parts of their economic evaluation, the Assessment Group initially stratified their results according to three key patient characteristics: age, fitness (risk of operative mortality) and aneurysm size. Fitness in the model was represented by pre-existing conditions such as cardiac, pulmonary or renal insufficiency, which might predict operative mortality. The Assessment Group considered that because of the large number of combinations of potential risk factors and levels it would be more convenient to express fitness according to a single scale. In their analysis, the Assessment Group defined four levels of fitness: good fitness or no pre-existing conditions affecting operative mortality; moderate fitness, with twice the odds of operative mortality compared with a person of the same age and aneurysm size with good fitness; poor fitness, with four times the odds of operative mortality compared with a person of the same age and aneurysm size with good fitness; and very

poor fitness, with eight times the odds of operative mortality compared with a person of the same age and aneurysm size with good fitness.

### EVAR compared with OSR: methods

- 4.2.12 The model compared OSR with EVAR in patients with a diagnosed AAA of at least 5.5 cm in diameter who were considered fit for OSR. The perspective of the model was that of the NHS. The time horizon of the model was for the patient's lifetime. All costs used 2007 prices. Costs and health benefits in future years were discounted at a rate of 3.5% per year. The base-case model assumed that patients' age, fitness levels and aneurysm sizes at the time of the decision to undertake surgery influenced baseline risks, but that the effect of treatment on operative mortality (odds ratio) of EVAR versus OSR was constant for all patient groups.
- 4.2.13 Patients entered the model after the decision to operate had been made, and had a primary aneurysm repair procedure (that is, either EVAR or OSR). Following this, patients could die, convert from EVAR to OSR, or survive the procedure. Survivors passed into a Markov cohort model to estimate lifetime costs and QALYs. It was assumed that patients who converted from EVAR to OSR during the primary admission had the same long-term prognosis as those who had undergone OSR initially.
- 4.2.14 For the analyses, the results were stratified by patient fitness, age and aneurysm diameter. Each variable affected the parameter estimates, which were calculated using risk equations for operative mortality after EVAR and OSR, the rate of non-aneurysm deaths more than 30 days after aneurysm repair, the rate of late aneurysm-related death and the rate of late readmission for complications.
- 4.2.15 Costs were incurred in the model during the primary admission, in surveillance after surgery and if the patient was readmitted to hospital for an aneurysm-related complication. The costs and resources used during the primary procedures were estimated from the ITT analysis of EVAR 1. Resource use and costs for intensive care during the primary procedure were based on the actual use of ICUs and high-dependency units (HDUs) as recorded in EVAR 1. All patients undergoing EVAR, whether they experienced adverse events or not, were assumed to require regular specialist hospital outpatient attendances and

CT scans to monitor their aneurysm repair. In the base case, based on the results of a survey of UK hospitals participating in the EVAR trials, the Assessment Group assumed that patients required two surveillance visits during the first year and one visit per year thereafter. Based on the findings of EVAR 1, the Assessment Group assumed that HRQoL declined by 0.077 in the 6-month period following open surgery, by 0.027 following EVAR and by 0.077 after readmission. Patients without the need for re-intervention were assumed to recover to age- and sex-specific average population values of HRQoL 6 months after the procedure. The utility values more than 6 months after successful surgery were 0.78 for patients aged 75 years or younger and 0.75 for patients older than 75 years.

## **EVAR compared with OSR: results**

4.2.16 The cost-effectiveness results for EVAR compared with OSR were stratified by age, aneurysm size and fitness at baseline. For patients of moderate fitness, with aneurysms larger than 7.5 cm in diameter and aged older than 80 years, the cost-effectiveness estimate for EVAR was lower than £20,000 per QALY gained. For patients of poor fitness, with aneurysms of 5.5–6.0 cm in diameter and aged 75 years and older, the cost-effectiveness estimates for EVAR were also lower than £20,000 per QALY gained. The ICERs for EVAR for patients of good fitness, with any size of aneurysm and of any age, were estimated to be either higher than £30,000 per QALY gained or EVAR was dominated by OSR.

## **Immediate elective surgery (EVAR or OSR) compared with watchful waiting and no intervention: methods**

4.2.17 An exploratory analysis considered when surgery (with EVAR or OSR) might be cost effective, compared with no surgery or delaying the decision for patients at each age and aneurysm size. The Assessment Group assumed that the patient was evaluated every 6 months in the watchful waiting policy. The Assessment Group also assumed that surveillance was stopped if a decision was made to rule out surgery and there were no subsequent monetary costs to the healthcare system. The costs of deferral were the monitoring costs of CT scans and outpatient attendance, deaths while waiting and a time preference for current benefits rather than future benefits. The Assessment Group assumed patients had normal HRQoL for their age while under surveillance, although it was recognised that evidence suggested that patients with diagnosed untreated aneurysm suffer anxiety.

4.2.18 A dynamic programme was constructed for this exploratory analysis to evaluate EVAR versus OSR and an option of no surgery. This estimated the net benefit of a watchful waiting strategy, and calculated the optimum policy (EVAR, OSR, no surgery or watchful waiting) for each aneurysm size and age.

### **Immediate elective surgery (EVAR or OSR) compared with watchful waiting and no intervention: results**

4.2.19 The base-case model (where EVAR was compared with OSR) estimated the ICERs for EVAR for patients of good fitness, with any size of aneurysm and of any age, to be either over £30,000 per QALY gained or EVAR was dominated by OSR. Including a watchful waiting or no-surgery strategy did not alter these results.

4.2.20 The following management strategies for patients of poor fitness were predicted to have an ICER of less than £20,000 per QALY gained: EVAR for aneurysm diameters of 5.5–7.4 cm and patients aged 74–78 years; OSR for aneurysm diameters of 5.5–7.4 cm and patients younger than 74 years; no surgery or watchful waiting for aneurysm diameters of 5.5–7.4 cm and patients older than 78 years; and EVAR for aneurysm diameters of 7.5 cm or greater and patients aged 83 years or younger.

4.2.21 The following management strategies for patients of very poor fitness were predicted to have an ICER of less than £20,000 per QALY gained: EVAR for aneurysms of 5.5–7.4 cm in diameter and patients aged 74 years or younger; no surgery or watchful waiting for aneurysms of 5.5–7.4 cm in diameter and patients older than 74 years; and EVAR for aneurysm sizes of 7.5 cm or greater and aged 78 years or younger.

4.2.22 The Assessment Group identified the following uncertainties within the model. The model comparing surgery with watchful waiting did not use treatment effects from RCTs. This was because the crossovers, delays and absence of a watchful waiting protocol in EVAR 2 made the results difficult to use directly to identify the most cost-effective form of management. Therefore, the Assessment Group could not use treatment effects from this trial to inform the model. Instead, the natural history of patients with untreated infra-renal aneurysms was estimated using rupture rates and growth rates obtained from a review of the literature, and compared with outcomes estimated by the model

of EVAR and OSR for patients with the same baseline characteristics. Given the uncertainties in the data, and the potential for bias in this non-randomised comparison, the Assessment Group intended their decision model and dynamic programme for watchful waiting to be exploratory.

## Assessment Group's additional analyses: methods

- 4.2.23 The Assessment Group undertook further analyses at the request of the Appraisal Committee. These analyses included a revised base case in which fitness scores, age and gender were aggregated to represent, as near as possible, an 'average' UK population that would be considered suitable for EVAR, and a hazard ratio for late AAA-related deaths with EVAR compared with OSR of 1.5. The Appraisal Committee also requested further sensitivity analyses including the following scenarios: a hazard ratio of late AAA-related deaths of 1.2; reduced rates of convergence of the survival curves after EVAR and OSR; the current range of prices of endovascular stents paid by the NHS in England and Wales; and the relative cost of the procedures.
- 4.2.24 In order to construct the revised base case based on an average UK population, the Assessment Group compared the mean age and aneurysm size and mortality of the patients in the EVAR 1 trial, RETA and EUROSTAR. On the basis of these sources and clinical opinion, it was thought that an operative mortality for EVAR of approximately 2% would be fairly representative of average UK clinical practice. The Assessment Group used the risk equation for calculating operative mortality to indicate which population had an operative mortality similar to the estimate of the expected operative mortality of 2% after EVAR. The risk equation indicated that patients aged 75 years, with moderate fitness and an aneurysm of 6.5 cm in diameter were predicted to have an operative mortality of 2.1%.
- 4.2.25 The original base case used a hazard ratio for late AAA-related deaths of 2.46 (95% CI 0.48 to 12.7). The revised base case used a hazard ratio of 1.5 over the entire model time horizon. Sensitivity analyses explored the effect of a lower hazard ratio of 1.2, and a declining parameter value where the hazard ratio was 2.46 for the first 4 years and 1.0 thereafter.
- 4.2.26 The original model assumed an initial non-aneurysm mortality after EVAR until the cumulative rates of all-cause mortality were equal. The original hazard ratio

for excess mortality was 1.072, based on EVAR 1 trial data. In the additional analyses, the Assessment Group varied the rate of excess late non-aneurysm mortality in a sensitivity analysis from 1 (no excess late mortality after EVAR) to 1.144.

- 4.2.27 The original base case used a hazard ratio of 6.7 for late re-interventions for aneurysm-related complications for EVAR compared with OSR. In the revised analyses, the Assessment Group undertook a sensitivity analysis using a lower hazard ratio of re-intervention of 1.5.
- 4.2.28 The original base case used a cost for the EVAR procedure (including the cost of the device) of £10,416 and for the open procedure of £9893, a difference of £523. For the revised analyses, sample data were obtained from the NHS Purchasing and Supply Agency for NHS organisations in England for the mean price of an endovascular stent-graft. The price of endovascular stent-grafts used in the additional analyses was based on an average of £5000 (irrespective of the number of components required). The Assessment Group also undertook sensitivity analyses where the cost of the EVAR procedure was £1150 lower than in the original base case (that is, EVAR and OSR had the same initial procedure cost).
- 4.2.29 On the basis of a survey of hospitals, the original Assessment Group model included two CT scans in the first year and one each year thereafter. Because practice varied between centres, the Assessment Group undertook sensitivity analyses that considered lower annual costs, representing the use of cheaper technology such as duplex ultrasound and/or less frequent attendance.
- 4.2.30 As in their original model, the Assessment Group also considered patients of good fitness and patients of moderate and poor fitness separately. The Assessment Group defined good fitness here as the absence of renal disease, an ASA score of I or II, and the surgeon's assessment that the patient was suitable for open surgery.

### Assessment Group's additional analyses: results

- 4.2.31 The revised base case used patient characteristics set to the average population, that is, age 75 years, moderate fitness, and an aneurysm 6.5 cm in diameter. The ICER for the revised base case, with a hazard ratio for late AAA-related deaths

with EVAR relative to OSR of 2.46, was £121,725 per QALY gained. The ICER for the revised base case, with a hazard ratio of late aneurysm deaths of 1.5 for the lifetime of the patient, was approximately £49,000 per QALY gained.

- 4.2.32 The model includes an initial excess hazard of late non-aneurysm death after EVAR until the survival curves converge at 3 years. In the revised base case, if the excess hazard was set such that the survival curves converged at 8 years (with other parameters as the revised base case), then the ICER was approximately £22,000 per QALY gained. If the excess hazard was twice that of the base case, the survival curves converged at 2 years and the ICER was approximately £96,000 per QALY gained.
- 4.2.33 The revised base case assumed that the hazard of late aneurysm death was 1.5 times greater after EVAR than after OSR, for the lifetime of the patient. If there was no difference between treatments (hazard ratio 1.0) and all other parameters in the revised base case remained the same, then the ICER was approximately £29,000 per QALY gained. If the hazard ratio of late aneurysm death was 1.2, the ICER was approximately £37,000 per QALY gained.
- 4.2.34 The original base case in the assessment report assumed that the hazard ratio of late re-intervention was 6.7 for the lifetime of the patient, although the absolute rate of re-intervention declined over time and was low (about 2% per year) 4 years after EVAR. In the revised base case, if there was no difference between treatments (hazard ratio 1.0), the ICER was approximately £27,000 per QALY gained. If the hazard ratio of late re-intervention was 1.5 (the same as that of late aneurysm death) the ICER was £29,000 per QALY gained.
- 4.2.35 The revised base case assumed that one follow-up with CT per year was required after EVAR. If the cost per year was half that used in the revised base case (£54 per annum compared with £108), then the ICER was £44,000 per QALY gained. If there were no follow-up visits in the revised base case (while re-interventions and aneurysm deaths were unchanged), the ICER was approximately £39,000 per QALY gained.
- 4.2.36 The revised base case assumed that the EVAR procedure cost £523 more than OSR. If it was assumed that the EVAR procedure cost £623 less than OSR, the ICER was approximately £21,000 per QALY gained. Alternatively, if it was

assumed that the EVAR procedure cost the same as OSR, the ICER was approximately £36,000 per QALY gained.

4.2.37 In a multivariate sensitivity analysis the values in the revised base case were changed as follows: 1.5 for the hazard ratio of late re-intervention; the initial EVAR procedure cost the same as OSR; and the procedure costs of intervention and follow-up were £54 per annum. The resulting ICER was approximately £12,000 per QALY gained for all patients, £71,000 per QALY gained for patients of good fitness and £9000 per QALY gained for patients of moderate and poor fitness.

### 4.3 *Consideration of the evidence*

4.3.1 The Appraisal Committee reviewed the data available on the clinical and cost effectiveness of endovascular stent-grafts for AAAs, having considered evidence on the nature of the condition and the value placed on the benefits of endovascular stent-grafts by people with AAAs, those who represent them, and clinical specialists. It was also mindful of the need to take account of the effective use of NHS resources.

4.3.2 The Committee considered the care pathway for people with infra-renal AAAs and the potential place of endovascular stent-grafts in such a pathway. The Committee heard from clinical specialists that EVAR is now routinely considered as part of the management of infra-renal AAAs. The Committee recognised that to identify patients for whom EVAR was appropriate it is necessary to take account not only of the size of the aneurysm but also of other factors such as physiological measures of the person's fitness for surgery and aneurysm morphology, and patient choice. The Committee heard from the clinical specialists that these factors are assessed on a case-by-case basis by a specialist clinician experienced in the management of AAAs. The Committee concluded that it was essential to determine the appropriateness of EVAR through assessment by a specialist clinician experienced in the management of aortic aneurysms.

4.3.3 The Committee examined the clinical-effectiveness evidence for EVAR for patients with unruptured infra-renal aneurysms for whom elective surgical repair was considered appropriate. The Committee noted that the four RCTs and three registries identified showed that EVAR had benefits in terms of

reduced rates of operative and aneurysm-related mortality over the medium term. The Committee also noted that EVAR offered no significant difference in all-cause mortality at medium term and was associated with increased rates of complications and re-interventions compared with OSR. The Committee heard from the clinical specialists that the rates reported in the trials for long-term aneurysm-related death, complications and re-intervention following EVAR were higher than those seen currently in UK clinical practice. The Committee heard that these trials used older stent-grafts, and that the technology has significantly improved since the RCTs were carried out. In addition, clinical expertise both in assessing patients' suitability for EVAR and in undertaking the procedure has improved with more widespread use of the technology. The Committee was persuaded that the benefits of EVAR compared with OSR in current UK clinical practice were likely to be greater than those seen in the RCTs.

- 4.3.4 The Committee next considered whether there was any evidence of differences in the clinical effectiveness of the various types of endovascular stent-grafts available. It noted that only two of the five endovascular stent-grafts had been compared head-to-head in RCTs and that these studies showed no statistically significant differences between the outcomes. The Committee heard from the clinical specialists that the different endovascular stent-grafts are clinically comparable and that, in practice, any of the endovascular stent-grafts would be used with the choice of device depending on factors such as a patient's anatomy and aneurysm morphology.
- 4.3.5 The Committee examined the economic modelling that had been carried out for the appraisal. The Committee noted that in the Assessment Group's original base-case analyses estimates of cost effectiveness were stratified by age, aneurysm size and fitness. The clinical specialists agreed that the selection of a patient for EVAR depended on a number of factors such as age, aneurysm morphology and fitness for surgery, but stated that there was no accepted definition of fitness for surgery and that this was usually a subjective decision made by the surgeon. The Committee accepted that because there were no universally accepted criteria for assessing operative risk for aneurysm surgery, the fitness and age criteria used in the original Assessment Group's economic model could not be routinely reproduced in clinical practice. The Committee concluded that it was not appropriate for the subgroups to be stratified as done in the original Assessment Group's economic model and therefore the estimates

should be merged to take account of the average UK population characteristics that would be considered for EVAR.

- 4.3.6 The Committee considered the revised base case presented by the Assessment Group in which fitness scores and age were aggregated to represent, as closely as possible, the average UK population that would be considered for EVAR. The Committee noted that following the revised base case the ICER for EVAR compared with OSR was £122,000 per QALY gained.
- 4.3.7 The Committee then discussed the key parameters in the Assessment Group's economic model. The Committee considered the different approaches used for modelling the rate of convergence of the survival curves after EVAR and OSR. The Committee was aware that the rate of convergence of the survival curves depended on the balance between operative mortality and excess late non-aneurysm-related deaths. The Committee noted that the Assessment Group's model included input values for excess late non-aneurysm mortality after EVAR in contrast to the model submitted by the manufacturer. The Committee heard from the clinical specialists that most of the long-term non-aneurysm mortality seen in clinical practice was related to cardiovascular disease. The Committee was aware that the value of 1.072 used by the Assessment Group for long-term non-aneurysm mortality in their original base case had been obtained from the EVAR 1 trial. The Committee was also aware that the Assessment Group had varied the rate of excess late non-aneurysm mortality in their revised sensitivity analyses from 1.0 to 1.144. The Committee noted the effect of changing the values for excess non-aneurysm mortality after EVAR on the predicted convergence of the survival curves. The Committee was persuaded that, although there was uncertainty about the value for excess non-aneurysm mortality after EVAR, the value of 1.072 used by the Assessment Group in both their original and revised base-case analyses was plausible and appropriate given the empirical data available.
- 4.3.8 The Committee considered the values used by the Assessment Group and the manufacturer for the hazard ratio for late aneurysm-related deaths. The Committee noted that the hazard ratio used by the Assessment Group in their original base case (hazard ratio 2.46) was higher than that used by the manufacturer (hazard ratio 1.0). The Committee noted that the hazard ratio used by the Assessment Group was not statistically significant and was based on a very small number of deaths. The clinical specialists agreed that the rate of

late aneurysm-related deaths seen in UK clinical practice was higher for those patients receiving EVAR compared with OSR, but that the hazard ratio would be much lower than that presented by the Assessment Group. The Committee discussed the range of possible values for the hazard ratio of late aneurysm-related deaths and their relevance to UK practice and concluded that a hazard ratio of 1.5 was most appropriate.

- 4.3.9 The Committee considered the hazard ratio used in the model for re-intervention after EVAR (6.7) and noted that the ratio used by the Assessment Group had been obtained from the EVAR 1 trial. The Committee heard from the clinical specialists that clinicians are less inclined to re-intervene in current UK clinical practice than was the case during the RCTs. This was particularly true for type II endoleaks, which comprised the majority of re-interventions in the trials. The Committee concluded that it was appropriate to use a hazard ratio for re-interventions of 1.5 in the revised cost-effectiveness analysis.
- 4.3.10 The Committee then considered the differential costs of the initial procedures, either OSR or EVAR, which included operating theatre time, intensive care and ward stay as well as the cost of the stent-graft. The Committee noted that the resource use and costs for operating theatre time, intensive care and ward stay for EVAR used in the Assessment Group's model were higher than those used in the manufacturer's model and that this difference in resource use was due to slight differences in the estimates for length of stay in operating theatres, HDUs and ICUs. The Committee understood that these differences were because the input costs in the Assessment Group's economic model were based on the actual costs and resources used in the EVAR 1 trial, whereas those in the manufacturer's model had been derived from a number of other sources. The Committee was aware of the effect of the differing relative costs on the cost-effectiveness estimates for EVAR from the sensitivity analyses undertaken by the Assessment Group in their original and revised base cases. The Committee heard from the clinical specialists that the length of stay in ICU and on the ward following EVAR had reduced since the trials were undertaken. The Committee was persuaded that the Assessment Group's original and revised base cases may have overestimated length of stay in hospital following EVAR. The Committee concluded that there was uncertainty around the exact costs for theatre time and length of stay in HDU and ICU, and that this would have a large effect on the cost-effectiveness estimates for EVAR.

- 4.3.11 The Committee then considered the cost of the stent-grafts and heard from the clinical specialists that there were different procurement arrangements available for purchasing endovascular stent-grafts and, as with many devices, no nationally agreed price currently exists. However, the Committee noted from additional information obtained from sample data that the current procurement price for endovascular stent-grafts was on average £5000, irrespective of the number of components used. The Committee therefore concluded, taking into account the total procedural costs as discussed in section 4.3.10, that if the price of the stent-graft was on average no more than £5000 it was plausible to assume that there would be no difference in the initial procedure cost between EVAR and OSR.
- 4.3.12 The Committee also considered the costs of follow-up after EVAR. The Committee noted that in their original base case the Assessment Group had included follow-up by CT scan whereas the manufacturer had assumed that 50% of patients would receive follow-up monitoring by CT and the remaining 50% would receive follow-up monitoring by duplex ultrasound scan, to reflect changing clinical practice in the UK. The Committee heard testimony from the clinical specialists that for patients undergoing EVAR, duplex ultrasound scanning had largely replaced the need for CT. The Committee was therefore persuaded that the cost of follow-up after EVAR may have been overestimated in the Assessment Group's original and revised base cases. The Committee was persuaded that although there was uncertainty about the costs of follow-up after EVAR, the reduced costs (£54) used by the Assessment Group in their sensitivity analyses on their revised base case represented a plausible estimate to use for the cost-effectiveness analysis.
- 4.3.13 The Committee agreed to use the following parameter values as the basis for their discussions:
- a hazard ratio for late aneurysm deaths of 1.5
  - an excess non-aneurysm mortality after EVAR of 1.072
  - a hazard ratio for late re-intervention of 1.5
  - an annual cost of follow-up for EVAR of £54
  - no cost differential for EVAR and OSR for the initial procedure (where the average device cost is no greater than £5000).

The Committee noted that the ICER for the treatment of an average patient (defined as a 75-year-old patient of moderate fitness with an aneurysm of 6.5 cm diameter) with EVAR was £12,000 per QALY gained. The Committee concluded, therefore, that endovascular stent-grafts are an appropriate use of NHS resources.

- 4.3.14 The Committee noted that the Assessment Group had undertaken further sensitivity analyses on the scenario described in 4.3.13 where 'moderate and poor fitness' and 'good fitness' rather than 'the average patient' were used in the revised economic analyses. The Committee noted that the ICERs for these two additional scenarios were £9,000 and £71,000 per QALY gained based on QALY gains of 0.070 and 0.008 respectively for moderate and poor fitness and good fitness. The Committee noted that the ICER presented by the Assessment Group for patients of good fitness suggested that EVAR was not what would be usually agreed as a good use of NHS resources in these patients. The Committee considered that the difference in QALYs between the different subgroups was due to the absolute differences in operative mortality between EVAR and OSR for these patient groups. For the moderate and poor fitness patients the operative mortality rate for EVAR and OSR was assumed in the model to be 4% and 11% respectively. For the good fitness patients the operative mortality for EVAR and OSR was assumed in the model to be 1% and 3% respectively. The Committee was mindful that the relative differences in operative mortality were three times higher for OSR compared to EVAR for both the good fitness and moderate and poor fitness patients. The Committee acknowledged that this lack of a difference in relative operative mortality between the fitness subgroups would be part of the discussion between the clinician and patient during initial assessment of the appropriate choice of intervention.
- 4.3.15 The Committee next considered how fitness for surgical intervention (EVAR or OSR) should be assessed. It heard from the clinical specialists and consultees that assessment of a patient's fitness for surgical intervention for AAA involved assessment of the following factors: pre-operative investigations, clinical opinion on the suitability of OSR for an individual patient, overall life expectancy, age, and aneurysm size and morphology. Comments received during consultation suggested that fitness for surgery could be readily defined and therefore could form the basis for an appropriate distinction to be made between subgroups of patients which would be important to ensure a cost-effective use of resources. The Committee therefore reconsidered the Assessment Group's definitions of fitness as used in the economic model in

relation to whether they were clinically meaningful and could be implemented nationally. The Committee was also mindful that local protocols existed between clinicians and commissioners on how to assess patients' fitness for surgery and that these assessments were based on objective measures as well as clinical opinion. The Committee agreed that clinicians' assessment of the appropriateness of open surgery would be decided on a case-by-case basis. This would be reassessed at regular intervals based on a number of factors, including general overall fitness for surgery as well as aneurysm size and morphology. These factors could change over time. The Committee was persuaded that, as there were no nationally agreed definitions of fitness for surgery and no relative difference in the risk of operative mortality for 'good fitness' and 'moderate and poor fitness' patients, it would be inappropriate to exclude a specific subgroup of patients because there was no clear distinction between the patient subgroups based on differing levels of fitness. On this basis the Committee concluded that, although the cost-effectiveness estimate presented by the Assessment Group for patients of good fitness was higher than that normally considered to be a good use of NHS resources, endovascular stent-grafts could be considered a cost-effective treatment option for patients with unruptured infra-renal abdominal aortic aneurysms, for whom surgical intervention (OSR or EVAR) is considered appropriate. The Committee agreed however, that the decision on whether EVAR is preferred over OSR should be made jointly between the patient and their clinician after assessment of a number of factors including aneurysm size and morphology, patient age, general life expectancy, fitness for open surgery, the short- and long-term benefits and risks of the procedures including aneurysm-related mortality and operative mortality.

- 4.3.16 The Committee considered the treatment options for people who were considered unfit for OSR, but could receive EVAR. It was aware that the evidence base for EVAR in this situation was limited. The Committee noted that the economic model submitted by the Assessment Group explored the cost effectiveness of EVAR versus OSR including strategies of no intervention and watchful waiting. The Committee was mindful of the limitations of the model highlighted by the Assessment Group in the original assessment report and their intention that the analysis was exploratory. The Committee was also mindful that the cost-effectiveness estimates produced by the Assessment Group in their revised analyses applied only to patients who were considered suitable for EVAR or OSR. The Committee noted that there were no revised cost-effectiveness estimates available for patients who were not suitable for

OSR (primarily patients with very high operative risk) that might still be considered for EVAR. The Committee considered that given their conclusion that EVAR was a cost-effective treatment for patients of moderate and poor fitness based on the assumptions described in sections 4.3.13 and 4.3.14, then it was plausible that the cost-effectiveness estimate for EVAR for patients of very poor fitness would be similar. The Committee therefore concluded that EVAR would be an acceptable use of NHS resources in patients considered unfit for OSR in whom EVAR was considered appropriate.

4.3.17 The Committee was mindful that the data on the clinical effectiveness of EVAR came from trials and registries in which patients were treated predominantly by specialist clinicians working in units with significant annual throughput in terms of numbers of patients treated. The Committee considered whether such outcomes could be achieved in units with only developing expertise and lower annual patient numbers. The Committee heard from the clinical specialists that, in the UK, EVAR was undertaken in both specialist and non-specialist units. The clinical specialists stated that outcomes following EVAR were better for those patients undergoing the procedure in specialist units because of the higher numbers of cases treated and therefore the increased clinical expertise. The Committee reached the view that it was essential that EVAR be performed by clinicians experienced in the procedure and in the management of AAAs. The Committee therefore concluded that EVAR using endovascular stent-grafts should only be performed in specialist centres by clinical teams experienced in the management of AAAs. The teams should have appropriate expertise in all aspects of patient assessment and the use of endovascular aortic stent-grafts.

4.3.18 The Committee examined the clinical effectiveness of EVAR for ruptured aneurysms and was mindful of the limited published data. The Committee noted that no estimate of cost effectiveness had been provided by the Assessment Group or the manufacturers. The Committee heard from the clinical specialists that EVAR was used in UK clinical practice as a treatment option for patients with ruptured aneurysms. The Committee considered that the collection of more data on the clinical effectiveness of EVAR for ruptured aneurysms would enable a more precise estimate of the clinical and cost effectiveness of EVAR compared with OSR. Given the difficulties of conducting RCTs, the Committee considered that data should be collected through existing established registries and that all clinicians undertaking EVAR as a treatment for patients with ruptured aneurysms should (with their patient's consent) register the patient

with an existing registry in the UK. The Committee concluded that given the possible benefits of EVAR for ruptured aneurysms, and the feasibility of further registry data being collected, a recommendation for use only in research would be appropriate where patients are enrolled into existing registries.

## 5 Implementation

- 5.1 The Healthcare Commission assesses the performance of NHS organisations in meeting core and developmental standards set by the Department of Health in 'Standards for better health' issued in July 2004. The Secretary of State has directed that the NHS provides funding and resources for medicines and treatments that have been recommended by NICE technology appraisals normally within 3 months from the date that NICE publishes the guidance. Core standard C5 states that healthcare organisations should ensure they conform to NICE technology appraisals.
- 5.2 'Healthcare standards for Wales' was issued by the Welsh Assembly Government in May 2005 and provides a framework both for self-assessment by healthcare organisations and for external review and investigation by Healthcare Inspectorate Wales. Standard 12a requires healthcare organisations to ensure that patients and service users are provided with effective treatment and care that conforms to NICE technology appraisal guidance. The Assembly Minister for Health and Social Services issued a Direction in October 2003 that requires local health boards and NHS trusts to make funding available to enable the implementation of NICE technology appraisal guidance, normally within 3 months.
- 5.3 When NICE recommends a treatment 'as an option', the NHS must make sure it is available within the period set out in the paragraph above. This means that, if a patient has abdominal aortic aneurysms and the doctor responsible for their care thinks that endovascular stent-grafts are the right treatment, they should be available for use, in line with NICE's recommendations.
- 5.4 NICE has developed [tools](#) to help organisations implement this guidance (listed below).
- A costing statement explaining the resource impact of this guidance.
  - Audit support for monitoring local practice.

## 6 Recommendations for further research

6.1 The following trials are currently ongoing.

- The Elective Abdominal Aortic Aneurysm trial ACE is a French RCT comparing EVAR and OSR in patients aged 50 years and older with an AAA measuring 5 cm or more in diameter (4 cm or more if rapidly growing). The trial started in January 2003 with an expected completion date of January 2006. The date of publication has not been confirmed at present.
- The Amsterdam acute aneurysm trial is an RCT comparing EVAR and OSR in patients with a ruptured AAA. The trial was expected to end in August 2008.
- OVER (open surgery versus endovascular repair) is a large USA RCT comparing EVAR and OSR in patients aged 50 years and older with an AAA measuring 5 cm or more in diameter (4.5 cm or more if rapidly growing). The expected completion date is October 2011.
- CAESAR (comparison of surveillance versus aortic endografting for small aneurysm repair) is an RCT in Italy to compare EVAR with surveillance (and eventual treatment) in patients with AAAs of diameter 4.1–5.4 cm who are suitable for EVAR. Results are expected at the end of 2011.

6.2 Further research is needed on the management of ruptured aneurysms. Given the difficulties of conducting RCTs on the management of ruptured aneurysms, the collection of data through existing, established registries, particularly RETA (for EVAR) and NVD (for OSR) in the UK should be continued.

6.3 Research is required to measure the extent to which the relative treatment effect of EVAR on operative mortality can be assumed constant across subgroups of patients.

6.4 Research is required into how to incorporate the best available risk-scoring systems for the management of AAA into decision-making in routine clinical practice.

## 7 Related NICE guidance

- [Laparoscopic repair of abdominal aortic aneurysms](#). NICE interventional procedure guidance 229 (2007).
- [Stent-graft placement in abdominal aortic aneurysm](#). NICE interventional procedure guidance 163 (2006).

## 8 Review of guidance

- 8.1 The review date for a technology appraisal refers to the month and year in which the Guidance Executive will consider whether the technology should be reviewed. This decision will be taken in the light of information gathered by the Institute, and in consultation with consultees and commentators.
- 8.2 The guidance on this technology will be considered for review in March 2013.

Andrew Dillon  
Chief Executive  
February 2009

## Appendix A: Appraisal Committee members and NICE project team

### *A Appraisal Committee members*

The Appraisal Committee is a standing advisory committee of the Institute. Its members are appointed for a 3-year term. A list of the Committee members who took part in the discussions for this appraisal appears below. The Appraisal Committee meets three times a month except in December, when there are no meetings. The Committee membership is split into three branches, each with a chair and vice-chair. Each branch considers its own list of technologies and ongoing topics are not moved between the branches.

Committee members are asked to declare any interests in the technology to be appraised. If it is considered there is a conflict of interest, the member is excluded from participating further in that appraisal.

The minutes of each Appraisal Committee meeting, which include the names of the members who attended and their declarations of interests, are posted on the [NICE website](#).

#### **Professor Keith Abrams**

Professor of Medical Statistics, University of Leicester

#### **Dr Ray Armstrong**

Consultant Rheumatologist, Southampton General Hospital

#### **Dr Jeff Aronson**

Reader in Clinical Pharmacology, University Department of Primary Health Care, University of Oxford

#### **Dr Darren Ashcroft**

Reader in Medicines Usage and Safety, School of Pharmacy and Pharmaceutical Sciences, University of Manchester

#### **Professor David Barnett (Chair)**

Professor of Clinical Pharmacology, University of Leicester

#### **Dr Peter Barry**

Consultant in Paediatric Intensive Care, Leicester Royal Infirmary

**Professor Stirling Bryan**

Head, Department of Health Economics, University of Birmingham

**Professor John Cairns**

Public Health and Policy, London School of Hygiene and Tropical Medicine

**Dr Mark Charkravarty**

Director, External Relations, Procter and Gamble Health Care, Europe

**Professor Jack Dowie**

Health Economist, London School of Hygiene and Tropical Medicine

**Ms Lynn Field**

Nurse Director, Pan Birmingham Cancer Network

**Professor Christopher Fowler**

Professor of Surgical Education, Barts and The London School of Medicine and Dentistry, Queen Mary, University of London

**Dr Fergus Gleeson**

Consultant Radiologist, Churchill Hospital, Oxford

**Ms Sally Gooch**

Independent Nursing and Healthcare Consultant

**Mrs Barbara Greggains**

Lay Member

**Mrs Eleanor Grey**

Lay Member

**Mr Sanjay Gupta**

Former Service Manager in Stroke, Gastroenterology, Diabetes and Endocrinology, Basildon and Thurrock University Hospitals Foundation NHS Trust

**Mr Terence Lewis**

Lay Member

**Professor Gary McVeigh**

Professor of Cardiovascular Medicine, Queens University, Belfast

**Dr Ruairidh Milne**

Senior Lecturer in Public Health, National Coordinating Centre for Health Technology, University of Southampton

**Dr Rubin Minhas**

General Practitioner, CHD Clinical Lead, Medway PCT

**Dr John Pounsford**

Consultant Physician, Frenchay Hospital, Bristol

**Dr Rosalind Ramsay**

Consultant Psychiatrist, Adult Mental Health Services, Maudsley Hospital, London

**Dr Stephen Saltissi**

Consultant Cardiologist, Royal Liverpool University Hospital

**Dr Lindsay Smith**

General Practitioner, East Somerset Research Consortium

**Mr Roderick Smith**

Finance Director, West Kent PCT

**Mr Cliff Snelling**

Lay Member

**Professor Ken Stein (Vice Chair)**

Professor of Public Health, Peninsula College of Medicine and Dentistry, University of Exeter

**Professor Andrew Stevens**

Professor of Public Health, Department of Public Health and Epidemiology, University of Birmingham

**Ms Nathalie Verin**

Health Economics Manager, Boston Scientific UK & Ireland

**Dr Colin Watts**

Consultant Neurosurgeon, Addenbrookes Hospital

**Mr Thomas Wilson**

Director of Contracts and IM&T, Milton Keynes PCT

### *B NICE project team*

Each technology appraisal is assigned to a team consisting of one or more health technology analysts (who act as technical leads for the appraisal), a technical adviser and a project manager.

**Nicola Hay and Fay McCracken**

Technical Leads

**Joanna Richardson**

Technical Adviser

**Natalie Bemrose and Shaun Minehan**

Project Managers

## Appendix B: Sources of evidence considered by the Committee

A. The assessment report for this appraisal was prepared by the NHS Centre for Reviews and Dissemination and the Centre for Health Economics – University of York.

- Chambers D, Epstein D, Walker S et al. Endovascular stents for abdominal aortic aneurysms: a systematic review and economic model, April 2008.

B. The following organisations accepted the invitation to participate in this appraisal. They were invited to comment on the draft scope, assessment report and the appraisal consultation document (ACD). Organisations listed in I and II were also invited to make written submissions and have the opportunity to appeal against the final appraisal determination.

I) Manufacturers/sponsors:

- Cook (UK) Limited (The Zenith AAA Endovascular Graft with H&L-B One-Shot Introduction System)
- Le Maitre Ltd (UniFit Aorto-uni-iliac Endoluminal Stent Graft, POWERLINK) (UK Distributor Le Maitre Ltd, manufactured by Endologix)
- Lombard Medical Cardiovascular Devices Division (The Aorfix AAA Stent-graft)
- Medtronic Ltd (The TALENT Endoluminal Occluder System and the TALENT AUI Stent Graft with the Xcelerant Delivery System)
- Vascutek (Anaconda AAA Stent Graft System) (declined to participate)
- WL Gore and Associates (UK) Ltd (The EXCLUDER Endoprosthesis)

II) Professional/specialist and patient/carer groups:

- Association of Anaesthetists of Great Britain and Ireland
- British Cardiac Patients Association
- British Heart Foundation
- British Society for Endovascular Therapy
- British Society of Interventional Radiology

- HEART UK
- Royal College of Nursing
- Royal College of Physicians (Cardiology Committee)
- The Vascular Society

### III) Other consultees

- Department of Health
- North West Specialised Commissioning Group
- Welsh Assembly Government

### IV) Commentator organisations (did not provide written evidence and without the right of appeal)

- NHS Quality Improvement Scotland
- NHS Supply Chain
- WL Gore (BIFURCATED GORE-TEX® STRETCH Vascular Grafts, GORE-TEX® STRETCH Vascular Grafts – Standard-Walled Large Diameter)

C. The following individuals were selected from clinical specialist and patient advocate nominations from the non-manufacturer/sponsor consultees and commentators. They participated in the Appraisal Committee discussions and provided evidence to inform the Appraisal Committee's deliberations. They gave their expert personal view on endovascular stent-grafts for abdominal aortic aneurysms by attending the initial Committee discussion and/or providing written evidence to the Committee. They were invited to comment on the ACD.

- Professor Roger Greenhalgh, Head of the Department of Vascular Surgery, Imperial College London (clinical specialist)
- Mr Peter Taylor, Consultant Vascular and Endovascular Surgeon, Guy's and St Thomas' NHS Foundation Trust (clinical specialist)
- Professor Matt Thompson, British Society for Endovascular Therapy (clinical specialist)
- Mrs Anne Cheetham – nominated by the Vascular Society/Circulation Foundation (patient expert)

## Changes after publication

**February 2014:** implementation section updated to clarify that endovascular stent-grafts are recommended as an option for treating abdominal aortic aneurysms. Additional minor maintenance update also carried out.

**March 2012:** minor maintenance

## About this guidance

NICE technology appraisal guidance is about the use of new and existing medicines and treatments in the NHS in England and Wales.

This guidance was developed using the NICE [multiple technology appraisal](#) process.

We have produced a [summary of this guidance for patients and carers](#). Tools to help you put the guidance into practice and information about the evidence it is based on are also [available](#).

## Your responsibility

This guidance represents the views of NICE and was arrived at after careful consideration of the evidence available. Healthcare professionals are expected to take it fully into account when exercising their clinical judgement. However, the guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or guardian or carer.

Implementation of this guidance is the responsibility of local commissioners and/or providers. Commissioners and providers are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have regard to promoting equality of opportunity. Nothing in this guidance should be interpreted in a way which would be inconsistent with compliance with those duties.

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## Accreditation

