Should men screening positive for subaneurysmal aortas be entered in a lifelong ultrasound surveillance programme? A Rapid Evidence Summary.

External review against programme appraisal criteria for the UK National Screening Committee (UK NSC)

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Abbreviation List

AAA	Abdominal aortic aneurysm
EVAR	Endovascular aneurysm repair
GHQ	General Health Questionnaire
HADS	Hospital Anxiety and Depression Scale
ITI	Inner-to-inner
LELE	Leading-to-leading edge
MHC	Mental Health Cluster
MOSF36/SF-36	Medical Outcomes Study 36-Item Short-form Patients' Health Survey
NAAASP	National Abdominal Aortic Aneurysm Screening Program
NOS	Newcastle-Ottawa Scale
OHRI-KSG	Ottawa Hospital Research Institute – Knowledge Synthesis Group
OTO	Outer-to-outer
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
QoL	Quality of Life
RCT	Randomized Controlled Trial
ROB	Risk of bias
SR	Systematic review
UKNSC	United Kingdom National Screening Committee
WHOQOL-BREF	World Health Organization Quality of Life

Plain English Summary

This document reviews the evidence published since 1990 relating to subaneurysmal abdominal aortas in men aged 65 and older who are part of the general population.

The normal size of the adult abdominal aorta ranges from 1.2 to 2.4 cm in diameter, with a measurement of 2.5 to 2.9 cm in diameter being considered subaneurysmal. Presently, the UK National Health Service Abdominal Aortic Aneurysm Screening Programme (NAAASP) does not offer any follow-up screening to men who have an abdominal aortic measurement of 2.5 to 2.9 cm. Those having an abdominal aortic diameter of 3.0 cm or greater are considered aneurysmal, and are put on a lifelong surveillance programme. However, there is some evidence that men measuring in the subaneurysmal range will go on to develop an aneurysm within five years.

The UKNSC is considering including men who have subaneurysmal abdominal aortas into a lifelong ultrasound surveillance programme. To recommend this modification, this rapid evidence summary searched and evaluated studies that report on the prevalence of subaneurysmal aortas, growth rates, and risk factors that modulate growth. It also looked at the benefits and harms of entering a programme of lifelong ultrasound surveillance, and treatment for any large AAAs that develop in these men. This evidence summary found:

- That there was a small amount of information on several areas of interest, making it not possible:
  - to confidently determine that men with abdominal aortas measuring 2.5 to 2.9 cm should be followed in a lifelong ultrasound surveillance programme
  - to recommend a change to the current screening programme in the UK
- Overall prevalence varied, with a range of 1.14% to 8.53%. A high percentage (55-88%) of subaneurysmal men progressed to aneurysmal rates at five years follow-up.
- Only one study reported the risk factors for growth in these men.
- Many different tools were used to measure quality of life, and comparison groups varied between studies. Follow-up times were relatively short, usually six months to one year after screening or surgery. SF-36 was the most commonly used tool to measure QoL, and QoL was typically lower in people with AAA. Anxiety and depression levels did not differ significantly between comparison groups in any studies.
- Only four studies reported on the number of men who initially screen as subaneurysmal who went on to surgery (elective or emergency). Few men starting at a subaneurysmal level required surgery, and among those who did, mortality rates were much lower in those receiving elective surgery compared to those receiving emergency surgery due to rupture.

On the basis of the studies considered in this review, there is not yet sufficient evidence to recommend surveillance in men with subaneurysmal aortas.

Executive Summary

Abdominal aortic aneurysm (AAA) is a disease which is most commonly seen in Caucasian men, aged 65 years and older, who smoke. Other diseases constitute risk factors for these aneurysms, including diabetes, chronic obstructive pulmonary disease, and hypertension. Most screening programmes, including the UK National Health Service Abdominal Aortic Aneurysm Screening Programme (NAAASP), do not provide surveillance for men with abdominal aortas measuring <3.0 cm (subaneurysmal), although measurements between 2.5 to 2.9 cm are not considered normal, and in some men with these measurements have been shown to increase to aneurysmal levels within five years. AAA usually causes no symptoms, but if it ruptures, it is usually fatal.

The current evidence summary explores the quantity, quality, and direction of the literature published since 1990. The aim was to determine whether any substantive evidence has been published which could inform the discussion on including men aged 65 years and older having an abdominal aorta measuring 2.5 to 2.9 cm into a lifelong ultrasound surveillance programme. It also provides a judgement on whether the evidence suggests that reconsideration of the UKNSC's current policy is warranted at this point.

Overall, there was an insufficient amount of evidence to confidently state if there are harms or benefits of including men screening positive for subaneurysmal aortas into a lifelong ultrasound surveillance programme. Due to the volume of the literature, it is difficult to confidently conclude if men measuring with subaneurysmal aortas should be entered into a surveillance programme. This was based on the following evidence:

Key Question 1. Is the epidemiology and natural history of subaneurysmal aortas understood?

- screening is likely to detect a substantial number of men measuring subaneurysmally. However studies provided a wide range of prevalence, ranging from 1.14% to 8.53%. This wide range could be due to the age of the men included in the studies, as some studies included only 65 year olds, while others included all men 65 and older. Newer studies tended to report lower rates of subaneurysmal men, showing a possible trend of lowering rates of subaneurysmal aortas. Study size also varied largely, ranging from as few as 128 men to as many as 15,447 men. Lastly, studies defined what was considered subaneurysmal differently, for example, some reporting 2.6-2.9 cm, 2.7-3.0 cm, or 2.5-2.9 cm.
- a high proportion of men appear to progress from subaneurysmal to aneurysmal within a five year period. However only four studies reported on growth. These provide an overall rate of conversion from subaneurysmal to aneurysmal of 58.6%. This number must be carefully considered in terms of the age of participants at baseline, the range considered subaneurysmal, and length of follow-up time. Although there is a high prevalence of conversion, the proportion of those growing from subaneurysmal to medium and large aneurysms is typically low, and those that did progress to these sizes took a substantial amount of time.
- growth rates were reported differently in all included studies. Some studies reported mean growth rates, while others discussed rapid expansion. It is not possible to combine any of these results and to conclude on overall growth rates of subaneurysmal aortas.
- only one study evaluated risk factors for growth among subaneurysmal men and found that the infrarenal aortic diameter at age 65, a subaneurysmal aorta at age 65, and current smoking were risk factors for growth.

Key Question 2. What are the psychological harms associated with screening positive with an abdominal aortic aneurysm and/or entry to a surveillance programme?

- no studies focussed on men who screened subaneurysmally, so the findings are based on all men who were screened or who had entered a lifelong surveillance programme.
- numerous quality of life tools were used to measure overall quality of life, anxiety and depression, and general health in the included studies. Due to the heterogeneity in the tools used, the comparison groups evaluated, and the results, it is difficult to conclude if there are any psychological harms or benefits of screening and entering a surveillance programme.
- there were problems relating to the study methods and the conduct which increases the uncertainty of the finding, resulting in a high risk of bias in observational studies evaluating psychological harms and benefits, mainly due to: (i) low participation rates, possibly impacting the representativeness of the participants; (ii) ascertainment of outcomes was done through self-report, which can be highly variable depending on how a person feels on the particular day they are responding to the questionnaire; and (iii) short follow-up times.

Key Question 3. What outcomes relating to surgical intervention have been reported in men who have progressed from subaneurysmal to aneurysmal?

- only four studies followed men who initially measured subaneurysmal to those requiring surgery. Two studies did not have any men progressing to elective or emergency surgery. In the remaining two studies there was an overall rate of 7.8% (74/943 receiving elective and 12/943 receiving emergency surgery).
- among those who received surgery, there were higher mortality rates among those receiving emergency surgery (50%; 6/12) compared to those receiving elective surgery (9.5%; 7/74).
- three randomized controlled trials evaluated the quality of life among men with AAA (measuring 4.0 to 5.4 cm) allocated either to early surgery or surveillance. As with the results of Key Question 2, there were little similarities in the results of these studies, and an overall theme was not possible to determine.

Conclusions and implications for policy

On the basis of the studies considered in this review, due to the quantity, quality, and consistency of the evidence base, there is not yet sufficient evidence to recommend lifelong ultrasound surveillance in men with subaneurysmal aortas.

Future research could focus on: (i) providing commonalties between studies to be able to provide data that can be synthesized and increase the volume and precision in the evidence; (ii) evaluating risk factors for growth, as there may be modifiable lifestyle factors that can be recommended to men to slow or stop the growth of abdominal aortas; (iii) providing additional details in research papers evaluating surgery and its outcomes, for example, the abdominal aortic diameter of men when they entered the surveillance programme. This may have allowed for additional studies to be included in this evidence summary.

Introduction

Abdominal aortic aneurysms

An aneurysm is defined as a focal enlargement of an artery to greater than 1.5 times its normal diameter. The normal size of the adult abdominal aorta ranges from 1.2 to 2.4 cm, with a diameter measuring larger than 3.0 cm considered an abdominal aortic aneurysm (AAA).[1] Surgical treatment is considered once the aorta reaches a threshold of 5.5 cm in diameter. These are the thresholds used in ultrasound screening programmes in Sweden, England, Scotland, Wales, and Northern Ireland, with the USA using >5.0 cm as the threshold for surgery.[2]

Risk factors for AAA are ethnicity (white), sex (male), tobacco use, advanced age, and diseases, such as chronic obstructive pulmonary disease, diabetes and hypertension.[3,4] Up to 80% of patients with ruptured AAA will not survive; and most AAAs are asymptomatic until they rupture.[5] Detecting and treating an AAA before rupture is vital, as the mortality rate of AAA repair has been shown to be significantly lower when performed electively rather than as an emergency (24/414 (6%) vs 30/81 (37%)).[6] Elective AAA repair is the most effective therapy to prevent death from a rupture, with endovascular aneurysm repair (EVAR) and open surgery as the two options.

There are three categories of risk, based on aortic diameter, currently used in the UK National Health Service Abdominal Aortic Aneurysm Screening Programme (NAAASP) to direct the onward management of men who accept screening. These are:

- small aneurysms (3.0–4.4 cm): affecting approximately 1 in 80 screened men, these men are entered into an annual ultrasound surveillance programme
- medium aneurysms (4.5–5.4 cm): affecting approximately 1 in 500 screened men, these men are entered into a quarterly ultrasound surveillance programme
- large aneurysms (≥5.5 cm): affecting approximately 1 in 1000 screened men, these men are offered elective surgical intervention

The rate of growth of AAAs in men ranges from an average of 0.13-0.36 cm per year, with larger aneurysms growing at a faster rate than smaller ones.[7] Although ultrasound screening is quick, safe, inexpensive and well-tolerated by the individual,[8] there may be some level of anxiety or decreased quality of life if this individual screens positive and is placed into a lifelong surveillance programme.

Since the normal abdominal aorta diameter is up to 2.4 cm, and current screening programmes offer lifelong surveillance to those measuring 3.0 cm or greater, there has been some discussion as to how to manage men with aortas measuring between 2.5 and 2.9 cm (subaneurysmal aortas). Sweden is currently the only country which offers a 5-year follow-up scan for a measurement of 2.5-2.9 cm.[2] There is some evidence showing that men with subaneurysmal aortas will progress to AAA within five years. In a Swedish study, of the 2041 men with an aorta measuring <2.5 cm at 65, 0.7% had an AAA at 70. Whereas the 40 men with a subaneurysmal aorta at 65, 52.5% progressed to AAA at 70.[9] In the UK, Wild et al. had similar findings, reporting 59.6% (1,011/1,696) of individuals with subaneurysmal aortas developing AAA within five years, and 8.3% (140/1,696) having an AAA of >5.4 cm after a mean of 13.2 years.[10]

Objectives

Within the UK NAAASP there is discussion on whether the current three categories of risk should be broadened so that men with subaneurysmal aortas should be entered into this lifelong ultrasound

surveillance programme. The UK National Screening Committee (UKNSC) has identified the need to explore the volume and direction of the evidence on three issues relating to this overall question. The purpose of the review is to provide an evidence synthesis to allow further discussion on how the AAA screening programme and UKNSC might orientate towards this population and determine whether there is sufficient evidence to support decision making in the immediate term or if there is a need for longer term research on the harms and benefits of this strategy.

Rationale for a rapid evidence summary

The development of this rapid evidence summary began at the end of February 2016. The UKNSC programme modification process requires an assessment using rapid review methods to inform next steps. The UKNSC was interested in having the results by July 2016, in order to prepare for the UK National Screening Committee meeting in October of 2016.

Current rapid evidence summary, 2016

This rapid evidence summary was undertaken by the Knowledge Synthesis Group of the Ottawa Hospital Research Institute (OHRI-KSG), Canada, to identify and summarise the evidence. Rapid evidence summaries are produced using accelerated and/or modified systematic review methods in order to make concessions to accommodate an expedited turnaround time.[11,12,13] This rapid evidence summary was guided by an *a priori* protocol developed by OHRI-KSG in consultation with the UKNSC and UK NAASP. The protocol allowed for modifications in scope and analysis during the conduct of the rapid evidence summary, depending on the amount and nature of evidence that was retrieved. The UKNSC, UK NAASP and OHRI-KSG jointly discussed and agreed to these modifications. Decisions as to whether criteria were satisfied (met/not met/uncertain) were made solely based on the evidence of the rapid evidence summary.

Key questions

The question to be answered was "What are the benefits and harms for men aged 65 years and older with aortic diameter of 2.5-2.9 cm (subaneurysmal aorta) entering a programme of lifelong ultrasound surveillance and treatment for any large AAAs that develop?"

To answer this question, three key questions were addressed:

1. Is the epidemiology and natural history of subaneurysmal aortas understood?
   a. What is the prevalence of subaneurysmal aortas in men aged 65 years and older?
   b. What is the rate of growth from subaneurysms to small, medium, and large aortic diameters?
   c. What are the factors (if any) that modulate risk and rate of growth in this population?

2. What are the psychological harms associated with screening positive with an abdominal aortic aneurysm and/or entry to a lifelong surveillance programme?

3. What outcomes relating to surgical intervention have been reported in men who have progressed from subaneurysmal to aneurysmal?
   a. What proportion of men who have progressed from subaneurysmal to aneurysmal requiring surgery actually receive surgery?
   b. What are the benefits and harms of surgery in this population?

Methods

Literature search. An experienced medical information specialist developed the search strategy through an iterative process in consultation with the review team. The strategy was peer reviewed prior to execution by another senior information specialist using the PRESS checklist.[14] Using the OVID platform, we searched Ovid MEDLINE®, Ovid MEDLINE® In-Process & Other Non-Indexed Citations and Embase Classic+Embase on February 16, 2016. We also searched the Cochrane Library on Wiley (including the Cochrane Database of Systematic Reviews, DARE, CENTRAL, HTA and NHS EED) on the same date (**Appendix 1**). A second search targeting the psychological aspects of abdominal aortic aneurysm screening was performed in the same databases, as well as in two additional sources, PsycINFO (OVID platform) and CINAHL (Ebsco platform) on March 29, 2016 (**Appendix 2**). A combination of controlled vocabulary (e.g., MeSH terms) and keywords were used. Vocabulary and syntax were adjusted across databases. Animal-only studies were removed from the results. A focused grey literature search was performed (US Preventive Services Task Force – Abdominal Aortic Screening),[15] as agreed upon with the members of the review team.

Study selection. Search strategy records de-duplicated in Reference Manager were uploaded to the online Distiller Systematic Review Software© (DistillerSR, Evidence Partners, Ottawa, Canada). Two reviewers independently screened titles and abstracts for relevancy. A liberal accelerated method was used; when the first reviewer deemed a record not relevant, it was verified by a second reviewer. Records were assessed randomly, and the second reviewer was not aware if the first reviewer had assessed the record. Full-text reports of potentially relevant records were screened by two independent reviewers. Disagreements were resolved by consensus. Screening forms were pilot-tested before implementation: 50 records for title and abstracts, and 25 records for full-text reports. Reports that were co-publications or multiple reports of the same study were identified accordingly. Articles not available electronically were ordered. For practical consideration, only studies written in English were included. A list of citations excluded at full text has been provided (**Appendix 3**), and includes a list of potentially relevant records in other languages, abstracts, and articles not available in full-text format.

Data extraction. Information was extracted by one reviewer into DistillerSR, with 100% of studies verified by a second reviewer. Disagreements were resolved by consensus. Pilot testing was conducted on five studies (four quantitative and one qualitative).

Validity assessment. Randomized controlled trials (RCTs) were assessed using the Cochrane Risk of Bias tool (**Appendix 4**).[16] Cohort studies were assessed using a *modified* Newcastle-Ottawa (NOS) scale for cohort studies (**Appendix 5**).[17] We evaluated cross-sectional studies using three questions in the *modified* NOS-Cohort scale (**Appendix 6**). One reviewer assessed all included studies; with 100% of studies verified by a second reviewer. Disagreements were resolved by consensus.

Evidence synthesis. Heterogeneity between study groups prevented meta-analysis. Results are therefore presented narratively.

GRADE. Domains of the Grading Recommendations Assessment Development and Evaluation (GRADE) framework[18] were used to inform judgements on the quality of the body of evidence for each outcome.

Changes from protocol. As no systematic reviews (SR) fully answered any of the questions, we searched the bibliographies of six SRs to ensure we had retrieved all relevant primary studies. We have also included female respondents in the psychological harms question when the data was not provided separately from the men. Studies that include individuals <65 years of age were also included, however, the majority (~75%) of the participants had to be 65 years and older.

Definitions for classifying whether criteria were satisfied.

Met: Sufficient amount of quality evidence to confidently estimate an outcome or effect that is unlikely to be changed by further research or conducting a full assessment (SR/MA).

Not met: Insufficient amount of evidence or sufficient amount of evidence of poor quality to confidently estimate an outcome or effect. The estimates of the outcome (a) are likely to be changed by further research, (b) may change if a full assessment (SR/MA) was conducted; or (c) may be substantially different from the true effect. The criterion could also be deemed 'unmet' if the benefits of conducting a SR/MA are unclear.

Uncertain: The constraints of the rapid evidence summary methodology prevent a reliable answer to the question. There is a strong indication that a SR/MA should be pursued.

Eligibility criteria

KQ1. Is the epidemiology and natural history of subaneurysmal aortas understood?
    a. What is the prevalence of subaneurysmal aortas in men aged 65 years and older?
    b. What is the rate of growth from subaneurysms to small, medium, and large aortic diameters?
    c. What are the factors (if any) that modulate risk and rate of growth in this population?

Population	General male population, aged 65 years and older, who are undergoing screening for abdominal aortic aneurysms (AAA)
Interventions	Ultrasound using inner-to-inner (ITI), outer-to-outer (OTO), or leading-to-leading edge (LELE) measurements
Settings	No geographic and setting restrictions.
Outcomes	- Prevalence of subaneurysmal aortas (2.5-2.9 cm) - Rate of growth/expansion of subaneurysmal aortas over time - Factors for risk of growth and rate of growth
Time-frame	Publications dated January 1990 or later.
Study designs	Randomized controlled trials (RCT) or cluster controlled trials (CCTs), non-randomized controlled trials, cohort studies, cross-sectional studies
Language	English

KQ2. What are the psychological harms associated with screening positive with an abdominal aortic aneurysm and/or entry to a surveillance programme?

Population	General population, aged 65 years and older, who are undergoing screening for abdominal aortic aneurysms (AAA)
Interventions	Any quality of life measurement.
Settings	No geographic and setting restrictions.
Outcomes	Psychological outcomes, such as anxiety
Time-frame	Publications dated January 1990 or later.
Study designs	Randomized controlled trials (RCT) or cluster controlled trials (CCTs), non-randomized controlled trials, cohort studies, cross-sectional studies (ie. surveys, focus groups, interviews)
Language	English

KQ3. What outcomes relating to surgical intervention have been reported in men who have progressed from subaneurysmal to aneurysmal?
    a. What proportion of men who have progressed from subaneurysmal to aneurysmal requiring surgery actually receive surgery?
    b. What are the harms and benefits of surgery in this population?

Population	Male population, aged 65 years and older, who entered a screening programme for abdominal aortic aneurysms (AAA) with an aortic diameter of 2.5-2.9 cm
Interventions	Open, laparoscopic, or endovascular repair (EVAR) surgery
Settings	No geographic setting restrictions. Surgery performed in a hospital.
Outcomes	- Rate of men receiving surgery among those with aortic diameters requiring surgery - Surgery outcomes: all-cause mortality, aneurysm-related death, major complications (ie. heart attack), minor complications (ie. irregular heart rhythms), and psychological benefit (ie. quality of life)
Time-frame	Publications dated January 1990 or later.
Study Design	Questions 3a&b: Randomized controlled trials (RCT) or cluster controlled trials (CCTs), non-randomized controlled trials; Question 3a: cohort studies, cross-sectional studies
Language	English

Caveats for inclusion/exclusion

- We modified the population of inclusion for the psychological harms and benefits question (KQ2) to include all men who had been screened (in observational studies) or those randomized to screening or not (in randomized trials), regardless of aortic measurement diameter, as a proxy population for subaneurysmal men.
- We included studies that had participants under the age of 65, but extracted subgroup data for those 65 years and older, where available.
- We included studies that had women, but extracted subgroup data for men, where available. For KQ1 and KQ3, combined results for men and woman were included if there was a high proportion (~75%) of men. Otherwise, the study was excluded.

Summary of Findings

Literature search results

A total of 1,549 unique titles and abstracts were screened based on the first search which was specific to subaneurysmal aortas. The second search was expanded to include all those with AAA, and included an additional two databases (CINAHL and PsycINFO). This search provided an additional 2,990 unique records. The second search was screened only for those studies reporting on psychological harms. We also searched the bibliographies of six relevant systematic reviews, adding an additional three studies that were evaluated at full-text. Of these 4,542 records, 784 were considered eligible for full text assessment. There were a higher number of full text records than anticipated, as the second search contained 520 records with no abstract. We screened these records based on title and only excluded studies which were clearly not relevant to the key questions. A total of 37 studies met inclusion **(Figure 1)**. The records and reasons for exclusion at full text screening are provided in **Appendix 3**.

As the population of interest was modified for the psychological harms question, we reassessed those at full-text where it was marked as 'unclear' if men were included in the study. No additional studies were included after this reassessment.

Risk of bias

The Cochrane Risk of Bias tool was used to evaluate four randomized controlled trials (**Appendix 4**).[16] The majority of the studies were observational and were assessed using a modified version of the Newcastle-Ottawa Scale (NOS) for cohort studies (**Appendix 5**).[17] For the prevalence question, there were some cohort studies where only the baseline cross-sectional data was used, as the longitudinal results were not relevant to the question. We evaluated these studies using three relevant questions from the modified NOS-Cohort scale. For consistency, we also evaluated cross-sectional studies using this modified scale to ascertain if the population was representative, and if the exposure (method of outcomes ascertainment) and outcomes were obtained using valid methods (**Appendix 6**).
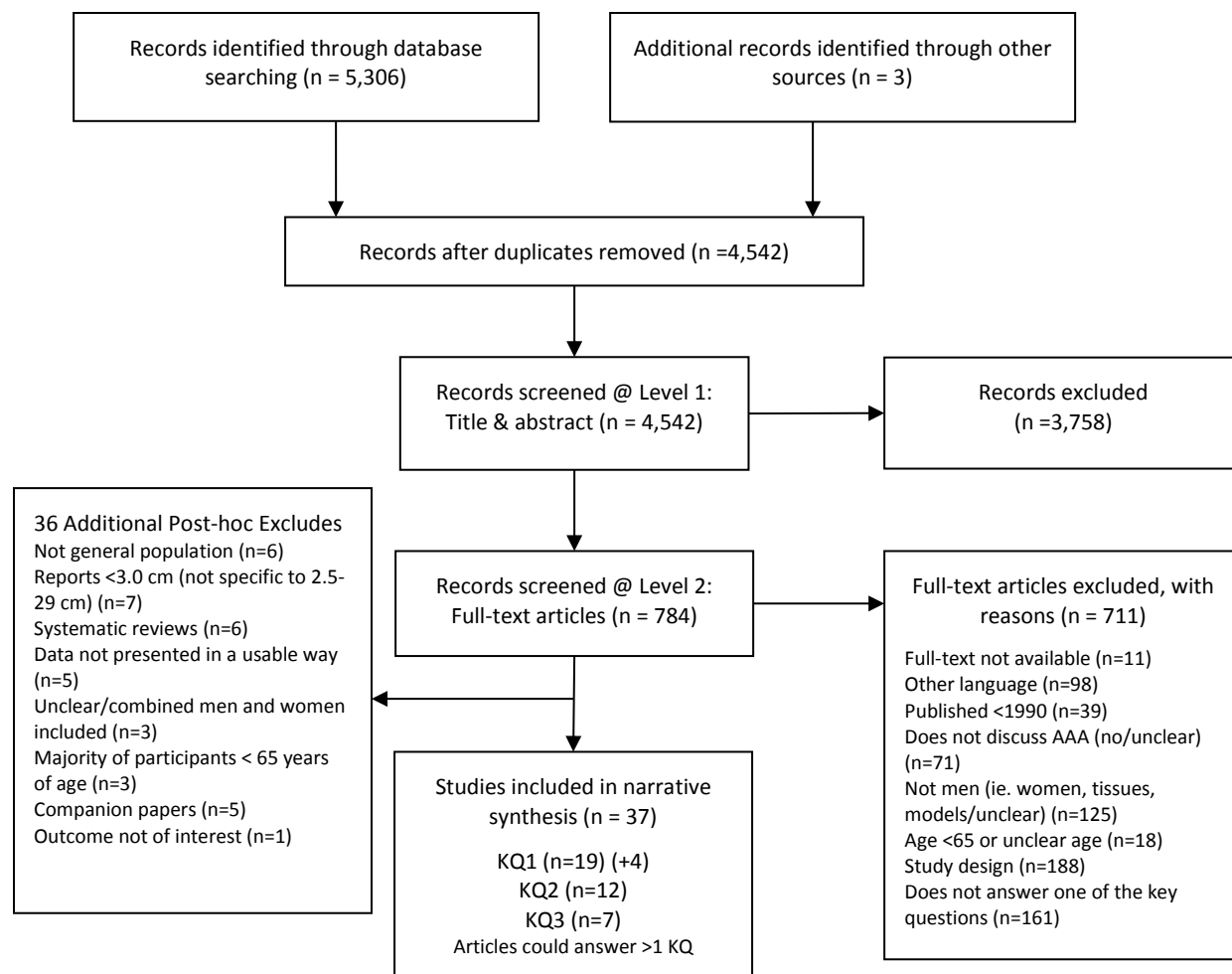
Figure 1. PRISMA flow diagram

Results

A detailed table of characteristics for the 37 included primary studies is provided in **Appendix 7.**

The study by Wild et al[10] includes data from eight community screening programmes (six in the UK, one in Finland, and one in Denmark). Three included studies[19,20,21] provide older prevalence and growth data than that reported in the Wild paper, and as such data is not reported for KQ1a and KQ1b and risk of bias was not done for these outcomes. However, these studies provide data for KQ3a[19,20,21] and KQ3b[19,20] and risk of bias was assessed for these outcomes. Watson 1997[22] is an update to the Collins 1991[23] study. Both studies are included, as Collins[23] provides data on growth rates (KQ2).

KQ1. Is the epidemiology and natural history of subaneurysmal aortas understood?

KQ1a. What is the prevalence of subaneurysmal aortas in men aged 65 years and older?

Nineteen studies reported the prevalence of men with subaneurysmal abdominal aortas. Four other studies provided prevalence data, but at earlier follow-up times, as discussed above.[19,20,21,23] Half of the studies took place in the UK (n=10), [10,22,24,25,26,27,28,29,30,31] two took place in both Sweden[9,32] and

Australia,[33,34] with one study each in Norway,[35] Belgium,[36] Italy,[37] and Japan.[38] It was unclear where one study took place, but the corresponding author was in the USA.[39] Prevalence data was taken cross-sectionally, but results were provided in six cross-sectional and 13 cohort studies. Cohort studies provided follow-up data for growth rates or other outcomes, such as mortality. Prevalence outcomes included mostly men aged 65 and older, while a few included those starting at 60 years old.

All of the screening was performed using ultrasound and most studies used the maximal anteroposterior and/or transverse diameter. Almost half of the studies reported measuring specifically the infrarenal aorta and seven others only stated that the abdominal aorta was measured. Six studies reported which measurement technique was used. Three used leading edge to leading edge,[9,35,39] one used inner to inner or outer to outer (depending on the community),[10] one used internal wall diameters,[26] and one used the external edge of the aortic wall.[36]

There was slight variation in how subaneurysmal aorta results were reported and/or defined. Eight studies reported 2.5-2.9 cm,[9,10,25,26,28,30,31,32] five others reported 2.6-2.9 cm,[22,24,27,34,37] two reported on each of 2.6-3.0 cm[29,36] and 2.5-3.0 cm,[38,39] and one on each of 2.7-3.0 cm[33] and 2.4-2.6 cm.[35]

Overall, the prevalence ranged from 1.14% to 8.53%. This wide range may be explained by the dates of data collection (ranging from 1991 to 2014), with newer studies tending to report lower rates. Another possibility is the age of the men screened, with some studies reporting only on 65 year old men, while others report those 65 years and older. And lastly, it could be due to the range of the diameter measurements that were considered subaneurysmal (ie. 2.5-2.9 cm or 2.7-3.0 cm).

Among the 13 studies that provided results for all men screened (ie. not a sub-population of those measuring 2.6-2.9 cm), a total of 64,168 men received ultrasound screening, with 2,705 measuring within the subaneurysmal range, an overall prevalence of 4.2%. One large study, with 15,447 participants, did not specify if all were men, but they were in the Staffordshire and South Cheshire AAA screening programmes, which include only men. Study sizes ranged from as few as 128 to 15,447 people being screened (median 2,667; mean 4,583).

Accurate prevalence rates were indeterminable in five studies because the total number of men screened in these communities was not provided,[10] or because the authors included a subpopulation initially measuring in a specific range.[22,27,35,39]

A table of results for included studies can be found in **Appendix 8**.

Risk of bias for KQ1a

Overall, studies scored as low risk of bias. As prevalence was evaluated cross-sectionally, we evaluated these on three questions derived from the Newcastle Ottawa Scale for cohort studies. Most of the studies represented the general population of men aged 65 years and older. Studies that included participants deemed not to be representative of the general population, were either because they had low rates of participation of invited men (<70%), or it was unclear how many men would have been part of the exposed cohort. As ultrasound was used to measure prevalence in all studies, this represented a valid method of ascertainment of exposure and outcome.

KQ1b. What is the rate of growth from subaneurysms to small, medium, and large aortic diameters?

Six studies looked at prevalence of growth from subaneurysmal to aneurysmal and growth rates among those starting in a screening programme at a subaneurysmal level.[9,10,23,27,35,39] Three studies took place in the UK, with one each in Sweden, Norway, and one in the USA (based on author affiliation).

Four studies[9,10,27,35] reported on growth from subaneurysmal to AAA. All studies reported on mean follow-up times of at least five years. Progression from subaneurysmal to aneurysmal aortic diameters was high, ranging from 9.5% to 88%, with a total of 1,112 of 1,898 men progressing from subaneurysmal to aneurysmal aortic diameters. It is important to note that the study reporting 9.5%,[35] progression started with an initial range of 24-26 mm. Excluding this study, the range was reduced to 55-88%. Reasons for this wide range may be explained by variation in the age of the participants at baseline and follow-up, and the length of follow-up time.

Progression from subaneurymsal diameters to medium and large diameters was less prevalent and took longer. In one study, of the 21 men who progressed from subaneurysmal to aneurysmal diameters, 15 were in the 3.0-3.9 cm range and six in the 4.0-5.4 cm range at five years follow-up.[9] In larger studies, 8/358 (2.2%) progressed from subaneurysmal to large aneurysms at five years follow-up,[27] and 140/1,696 (8.3%) had progressed from subaneurysmal to a large aneurysm (>5.4 cm) at a mean time of 13.2 years follow-up.[10]

Studies evaluating growth rates differ on how this was reported. One study reported on the one year annual rate of change, the maximum observed annual change, and the mean incremental growth rate,[23] while one study reported on the mean growth rates per year,[27]and another study reported the prevalence of rapid expansion (≥1.0cm/yr).[39] Among those with at least one year follow-up (mean 5.4 years), the mean growth rate was 1.69 mm/year (95%CI 1.56 to 1.82) (range 0.0-6.67 mm/year), changing slightly after a mean time of 7.2 years (1.71 mm/year (95% CI 1.57 to 1.85) (range 0.0-5.75 mm/year)). Chang et al reports on men and women combined (73% men), with few people experiencing rapid expansion among those 60-80+ (2/112 (1.8%) in the 60-70 year olds, 3/72 (4.8%) in the 70-80 year olds, and none (of 12) in those older than 80 years old).[39]

Risk of bias for KQ1b

Overall, the studies scored moderate risk of bias. Men were not representative of the overall general population, as these studies were measuring growth rates among subaneurysmal men, as this was the population of interest. All studies used an appropriate method of screening (ultrasound), but most did not specify measurement method. Growth rates were often not measured at five or more years after initial screening, thus not allowing adequate follow-up time for this outcome. Furthermore, one study did not report the follow-up time, and another study reported the one year mean annual rate of change, but did not specify if this was the first year after measuring subaneurysmally. Among studies with follow-up, most demonstrated low attrition rates.

KQ1c. What are the factors (if any) that modulate risk and rate of growth in this population?

Only one study[9] looked at risk factors for growth. In the multivariate regression analysis, statistically significant risk factors were: (i) the infrarenal aortic diameter at age 65; (ii) a subaneurysmal aorta at age 65; and (iii) current smoking.

GRADE summary for KQ1

Using the GRADE framework as a guide,[18] the quality of the body of evidence for all outcomes was assessed as very low. **INDIRECTNESS**. Most studies had a population that was somewhat representative of the general population of men 65 years old. Men who were not being seen by a general practioner and/or were too ill to attend screening would not have been represented in most studies. **RISK OF BIAS.** Overall, risk of bias was low for prevalence data and moderate for growth data (as described above). **INCONSISTENCY**. There were many inconsistencies among the included studies: (i) the diameter considered subaneurysmal varied between studies (ie. 25-30 mm, 26-29 mm, and 27-30 mm); (ii) the

age of the men included varied between studies; (iii) the years data was collected ranged from 1990 to 2015. As there is some evidence that aneurysms rates have decreased over time, this could have an impact on the prevalence of subaneurysmal rates; and (iv) most studies did not state which measurement method was used (ie. LELE), and as there is variation within the different methods, it is not possible to tell if the prevalence rates or growth rates would have been the same if they all used the same method. **IMPRECISION**. Due to the nature of the results, specifically the wide range of study sizes (142 to 52,690), the low rates of subaneurysmal men (in some studies), and the low volume of evidence providing information on growth rates and risk factors for growth, we cannot assess for imprecision within the width of confidence intervals. **PUBLICATION BIAS.** Discussed in the Interpretation of Evidence: Publication bias section.

Based on this assessment the criterion is not met.

KQ2. What are the psychological harms associated with screening positive with an abdominal aortic aneurysm and/or entry to a surveillance programme?

No studies evaluated psychological harms in men who measured with a subaneurysmal abdominal aorta. We modified the population of interest for this question to include all men and women who measured aneurysmal (3.0 cm or more) as a proxy for subaneurysmal men. There is, therefore, some degree of unrepresentativeness in the results.

Twelve studies evaluated the psychological/quality of life dimension of screening positive or being put on a lifelong surveillance programme. These studies included men and women aged 50 years and older. Four studies took place in Sweden, two studies took place in both the UK and Australia, and one study per country took place in Italy, Germany, Denmark, and the USA. Study designs varied: five studies were cohort designs[34,40,41,42,43] with short follow-up times, ranging from one month to 12 months after screening, and ranged from 69 to 365 participants at follow-up; four studies were cross-sectional,[44,45,46,47] of which three were qualitative and had a small number of men included (n=10, 3 and 15); one RCT randomized men to either surveillance or no surveillance and had a follow-up of 12 months;[6] and lastly, two studies had designs that were not definable using the DAMI[48] and AHRQ[49] algorithms, and we did not agree with the authors reported design.[50,51]

There was a high level of variability among the studies, in terms of:

- The tools used to evaluate quality of life: nine studies evaluated quality of life through validated tools, including the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36/MOSF36), the Hospital Anxiety and Depression Scale (HADS), EuroQoL EQ-5D, the World Health Organization Quality of Life (WHOQOL-BREF), ScreenQL, the General Health Questionnaire (GHQ), and the short-form state anxiety scale of the Spielberger state-trait anxiety scale. The last four of these tools were only reported in one publication each.
- The comparison groups within the individual studies: some studies compared men with AAA versus the general population, others compared men with AAA versus men with normal aortas, and within studies comparisons were made between men before and after screening.
- In the overall results: overall, men with AAA reported a lower quality of life than men with normal aortas, however there were very few similarities between studies on the outcome domains that were significantly different between different comparison groups. However, when evaluating depression and anxiety scores, there was no difference between any of the comparison groups.

A table of results for the studies evaluating quality of life can be found in **Appendix 9**.

Individual study reports

MOSF36. Five studies evaluated quality of life using the MOSF36 tool, which evaluated different domains of eight health concepts, including limitations in physical, social, and usual role activities, bodily pain, general mental health, vitality (energy and fatigue), and general health perceptions.

Men with AAA versus general population. Hinterseher[44] compared men with AAA undergoing surveillance to the general population (sex- and age-matched German). The role-physical and role-emotional concepts were significantly lower in the surveillance group, p=0.02 and p=0.003, respectively.

Men with AAA versus those with normal aortas. Three studies[34,41,42] compared men who screened positive with AAA to men who screened negative (normal aorta). There were few similar outcomes between studies. Among men with AAA compared to men with normal aortas, physical functioning was also significantly lower at 12-months follow-up[41] with another study reporting lower scores in the social functioning, pain and general health concepts at six months.[34] Lastly, Wanhainen reported significant differences in the physical and social functioning among men with AAA before and after screening (12 months), but no difference between the men with AAA and those with normal aortas.[42]

RCT comparing screening versus no screening.[6] One study compared men assigned to screening vs no screening. Those who screened positive had significantly lower scores on the physical health and mental health domains at six weeks post-screen than those who screened negative (normal aorta), p=0.003 for both domains.

EuroQoL EQ-5D. Three studies evaluated quality of life using the EQ-5D tool.[6,40.41] Overall, there was no significant difference in HRQoL scores before screening and at follow-up among the participants who had screened positive[40], no significant difference in scores between men with AAA and normal aortas in health-related quality of life.[41] However, there was significant differences in the self-rated health domain scores between those with AAA and those with normal aortas at six weeks after screening.[6]

HADS. Four studies used the HADS tool to measure levels of anxiety and depression.[6,34,41,50] There were no differences in scores in any of these studies, regardless of comparison groups (AAA men pre- and post-screening, men with AAA versus men with normal aortas, and men with AAA at one and six months post-screening) or follow-up time.

WHOQoL-BREF. Hinterseher[44] used the WHOQoL-BREF tool. Comparing the AAA surveillance group to age- and sex-matched general population, the surveillance group scored significantly lower in the physical health QOL domain (60.71 vs 66.48, p=0.04). There were no differences in the psychological health, social relationships, environment, and global QOL domains.

ScreenQL. Lindholt[51] found that men who screened positive with AAA scored significantly (p<0.05) lower on the health and quality of life domains compared to controls (men who had not been invited for screening).

General Health Questionnaire (GHQ). Lucarotti et al[43] evaluated the differences between normal and abnormal (those with AAA) men using the 28-item GHQ at pre-screening and one month post-screen. Pre-screen and post-screen scores did not differ between men with AAA and those with normal aortas. Men with AAA had significantly lower levels of anxiety between their pre- and post-test scores (p=0.04), although this was also found in men with normal aortas (p=0.03).

Spielberger state-trait anxiety scale. Ashton et al[6] reported no difference in state anxiety levels between men who screened positive compared to those who screened negative at six weeks after screening.

Qualitative studies. Three studies in small groups interviewed a total of 28 men with AAA.[45,46,47] Several themes emerged from these studies, with some common themes throughout.

Knowledge. There was varied knowledge about aortic aneurysms and surgical options. Some men had never heard of it, or if they had they reported knowing others who had gotten the surgery successfully or had died from the condition. Among the men who knew about the disease, they were aware that the AAA may grow and that it may become life-threatening. Some men found it difficult to wait to speak to their doctor about the results, but once they were able to talk to their doctors, the information provided was easily understood, gave them reassurance and a sense of security. Others felt that they had been given too little information. One suggested that the doctor could be withholding information.

Reaction. Most men were glad that they had taken part in the tests, and most thought it was good to know of their results. Some men had not thought much about the appointment for the ultrasound, as "one gets such a lot of things like this." However, some men were shocked by the information they had been given or felt that it would have been better not to know about it.

> "I was very disappointed when I got the message …for my part it was like to have your own death sentence." {Hansson 2012}

> "What you don't know won't hurt you." {Bertero 2010}

Security and trust of healthcare system/providers. Overall, the men who received the ultrasound felt confident to be under surveillance and felt positive about the health care system. They also reported that having a relationship of trust with their surgeon contributed to easing their worry.

> "… in some way or another it's super that they want to prevent and treat if something is a problem..." {Hansson 2012}

> "As long as they make these check-ups and they have me under superintendence they will know towards what direction it goes" {Bertero 2010}

Having no physical symptoms and anxiety of not being able to do anything about it. Many men said they did not experience any symptoms related to the aneurysm. Some also reported feeling anxious about the knowledge of having AAA and not being able to take any actions.

> "…its of no value to know that you have something that can be a problem in the future…"

Judgment and lifestyle. Some men felt they were being judged or criticized about their lifestyle or had already decided not to listen to public health advice about diet, exercise, and smoking. Some felt that changes in lifestyle demanded too much sacrifice and did not think it was worth the bother, while others took this information and changed their lifestyle.

> "I needed to be told about the consequences … I am too heavy … I have lost weight, about 15 kilo… and my cholesterol was too high…but now I am feeling good." {Bertero 2010}

Discussion and rationalisation. Some men were glad that their wives were there when they spoke to their doctors and that one way of coping with the results was to talk to family and friends. However,

some men avoided talking about it, as it might induce anxiety and fear. Some men reported distancing themselves from the diagnosis or discussing it in an objective depersonalised way.

Impact on daily living. Most men carried on living as usual. However, the knowledge of the AAA did bring some concern.

> *"I live as usual…but for certain…you have some thoughts…will it continue to expand or will it stop…" {Bertero 2010}*

Surgery. As one would expect, thoughts of surgery brought some worry. However, one man whose aorta expanded by >1.7 cm in the previous year, expressed his worry to his surgeon, and arranged for the surgery sooner than expected. This brought the sense of security of being under surveillance and that action was taken.

> *"Being worried…just wanting this to be done…//it was a relief to have this done…" {Bertero 2010}*

Living with other illness/disease. Other interviewees expressed that having other more serious illnesses such as pain or cancer overshadowed their concern for AAA.

> *"I was not worried (about getting knowledge about AAA), but what worried me was my pain. This is much more difficult; in fact this is really hard."{Brannstrom 2009}*

A comprehensive table of themes and subthemes can be found in **Appendix 10**.

Risk of bias for KQ2

One RCT evaluated the quality of life between those randomized to surveillance or not. Using the Cochrane Risk of Bias tool,[16] the overall risk of bias was moderate. The method of sequence generation was adequate; however, there was no description of the method or existence of allocation concealment. Due to the nature of the intervention and outcomes, it was not possible to blind the participants or personnel to group assignment, and the quality of life tools (ie. MOSF-36, HADS) were self-administered, not allowing for blinded outcome assessors. Loss to follow-up was reported, however the reasons why were not discussed, and authors did not report if there was any difference between those lost to follow-up compared to those who were not lost. The study was not registered, but the authors do report on each domain within the validated tools used.

Among the observational studies, risk of bias was moderate to high. Rates of participation were low in some studies because investigators did not ask most of the population of interest (ie. only men with AAA) or because those invited did not participate. As ascertainment of outcomes was done through self-administered quality of life tools or through interview, this may create a risk of bias, as responses to questions can be greatly impacted by how a person feels on any given day. Follow-up time did not meet the pre-specified time of five years, causing all studies to score high risk on this question.

Two observational studies were not evaluated for risk of bias, as we were not able to determine the study design, using the DAMI[48] and AHRQ[49] algorithms, and we did not agree with the authors reported design.

GRADE summary for KQ2

Using the GRADE framework as a guide,[18] the quality of the body of evidence for all outcomes was assessed as very low. **INDIRECTNESS**. Many studies had a population that was not representative of the general population of men 65 years old as this question was modified to include all men and women who were screened for AAA, there is a chance that it may not be good overall representation of the

population of interest (subaneurysmal men). **RISK OF BIAS.** There were many areas that contributed to moderate to high risk of bias assessments (as described above). **INCONSISTENCY.** There was variation between studies in the quality of life tools used and in the comparison groups (ie. men with AAA compared to the general population, men with AAA compared to men with normal aortas). There was also inconsistency in the results, with some reporting significant differences in some domains, but not others (especially found in the MOS SF-36 tool). However, this may also be due to comparison groups. **IMPRECISION.** Due to the nature of the results, specifically the small number of overall studies and the number of studies with <100 participants, we cannot assess for imprecision in terms of the width of confidence intervals. **PUBLICATION BIAS.** Discussed in the Interpretation of Evidence: Publication bias section.

Based on this assessment the criterion is not met.

KQ3. What outcomes relating to surgical intervention have been reported in men who have progressed from subaneurysmal to aneurysmal?

KQ3a. What proportion of men who have progressed from subaneurysmal to aneurysmal requiring surgery actually receive surgery?

Four studies reported on the proportion of men who had progressed from subaneurysmal to aneurysmal who required and/or received surgery.[9,19,20,21] Two studies took place in the UK, with one each in Sweden and Denmark. All studies were cohort designs, and typically had follow-up times of at least five years, with the exception of Hafez,[20] which had a follow-up time of two years.

Svensjo[9] and Lindholt[21] reported that no men measuring subaneurysmal at baseline had elective or emergency surgery to repair the AAA at five year follow-up. Overall, 7.8% of men who were originally screened as subaneurysmal went on to receive elective surgery (74/943), with 1.3% receiving emergency surgery (12/943).

Detailed results can be found in **Appendix 8**.

Risk of bias for KQ3a

Overall, risk of bias for the studies that reported on the prevalence of those who required surgery scored low risk. Men were generally well representative of the general population of men 65 and older. Although none of the studies made any adjustments to evaluate confounding, most studies had sufficient follow-up time and included many participants from baseline to follow-up.

KQ3b. What are the harms and benefits of surgery in this population?

Five studies looked at harms and benefits of surgery. Two studies evaluated surgery outcomes,[19,20] specifically mortality, and three randomized controlled trials evaluated quality of life for men allocated to early surgery compared to those allocated to surveillance. [52,53,54]

Surgery outcomes. Of the men who received elective surgery, 9.5% (7/74) experienced post-operative in-hospital mortality. The in-hospital mortality rate among men who received emergency surgery was 50% (6/12). Darwood reported that seven of the 13 men who experienced a ruptured aorta died prior to surgery.[19]

QoL surveillance versus early surgery. Three RCTs evaluated QoL among men with AAA measuring 4.0 to 5.4 cm (4.1 to 5.4 cm in one study). Two used the SF-36 questionnaire[52,53] and one used a 20-item variation of the SF questionnaire.[54] Two studies took place in the UK, and the other did not state where

the study took place (CAESAR trial), but the primary author affiliation was Italy. There were few similarities in results between studies. De Rango[52] reported that the overall total scores decreased for both surveillance and surgery groups between baseline and final follow-up (mean 31.8 months), with both groups experiencing lower physical functioning and vitality domain scores. Lederle[53] reported higher general health scores in the immediate repair group and higher vitality scores in the surveillance group using repeated measure analysis over seven years. In the UK Small Aneurysms Trial,[54] participants in the early surgery group reported significantly higher scores in the health perceptions domain, while bodily pain scores worsened significantly in the surveillance group at one year follow-up.

Risk of bias for KQ3b

Studies reporting on surgery outcomes were generally at low risk of bias. Men were generally representative of the general population of men aged 65 years and older. No adjustments were made for confounding and follow-up times (30 days) were used in both studies.

Using the Cochrane Risk of Bias tool,[16] the risk of bias was moderate for all three studies. Only one study used adequate methods of sequence generation; none described the method or existence of allocation concealment. Due to the nature of the intervention and outcomes, it was not possible to blind the participants or personnel to group assignment. All studies used self-administered validated SF-36 quality of life tool, not allowing for blinded outcome assessors. Loss to follow-up was reported in all studies, however the reasons why were not discussed, and authors did not report if there was any difference between those lost to follow-up compared to those who were not lost. Only one study was registered in Clinicaltrials.gov,[52] however the authors do report on each domain within the validated tools used. Groups were mostly similar at baseline in all studies, supporting adequate randomization.

GRADE summary for KQ3

Using the GRADE framework as a guide,[18] the quality of the body of evidence for the quality of life outcome was assessed as very low.

For RCTs. Quality of life outcomes started as high quality and were downgraded to very low: **INDIRECTNESS**. Studies included mostly men, but age of inclusion was as low as 50 years old. The participation rates were low in these studies. In addition, participants included in these studies had AAA measuring at least 4.0 cm in diameter. **RISK OF BIAS.** All studies were assessed at moderate risk of bias (as described above). **INCONSISTENCY**. In all studies, participants were randomized to early surgery or surveillance and were evaluated using similar QoL questionnaires. Significant differences in reported outcomes were different between the three trials. **IMPRECISION**. Due to the number of studies (n=3), and the variable study sizes (ranging from 360 to 1,136), we cannot assess for imprecision in terms of the width of confidence intervals. **PUBLICATION BIAS.** Discussed in the Interpretation of Evidence: Publication bias section.

For observational studies. Surgical outcomes started at low quality and were downgraded to very low: **INDIRECTNESS**. Most studies had a population that was somewhat representative of the general population of men 65 years old. All studies included only men, but men who were not seen by a general practioner and/or too ill to attend screening would not have been included. **RISK OF BIAS.** All four studies assessed had a low risk of bias (as discussed above). **INCONSISTENCY**. Follow-up times ranged from two years to a median of 7.9 years. **IMPRECISION**. Due to the nature of the results, specifically the number of studies that follow participants from a subaneurysmal aorta to those requiring surgery, and the surgical outcomes (n=2), we cannot assess for imprecision in terms of the extent of the width of

confidence intervals. **PUBLICATION BIAS.** Discussed in the Interpretation of Evidence: Publication bias section.

Based on this assessment the criterion is not met.

Discussion

The purpose of this rapid evidence summary was to evaluate the research looking at the prevalence of men aged 65 and older with subaneurysmal aortas, what are the psychological harms and benefits of putting these men on a lifelong surveillance programme, and among those who received surgery, what were the harms and benefits of surgery. In total, we found 37 studies that met our criteria to answer these questions.

Overall, there was a limited body of evidence. The included studies provided a wide range of men who measured subaneurysmally, with several different reasons why this may be (ie. the years that data was collected). The studies that reported on progression of growth from subaneurysmal to aneurysmal suggest that a significant proportion of subaneurysmal men will develop aortas with aneurysmal diameters, and that a small minority will develop to the point of eligibility for surgery. Only one study looked at risk factors for growth. As no studies evaluated the harms and benefits of lifelong surveillance programmes for subaneurysmal men, an expanded search of all men being screened or part of these surveillance programmes were included. Mixed results, differing comparison groups, and a variety of tools used to evaluate quality of life, anxiety and depression, and general health made it difficult to draw conclusions. There were very few studies on the proportion of eligible men who actually received surgery (among those followed subaneurysmally). The reviewed papers suggest that surgery outcomes follow the same pattern as AAA more generally with elective cases doing better in terms of mortality.

Due to the limited in volume and quality of the evidence, it is difficult to know if the potential benefits of screening in this population outweigh the potential harms of entering subaneurysmal men into lifelong surveillance programme.

Conclusion

On the basis of the reviewed studies, there is not yet sufficient evidence confidently recommend lifelong ultrasound surveillance in men with abdominal aortas measuring 2.5 to 2.9 cm. Further research is needed to support a change in the current UK screening policy.

Future research

As only one study evaluated the risk factors for growth for men initially measuring at subaneurysmal, additional research should be done in this area. There may be modifiable lifestyle factors that can be recommended to patients to slow or stop aneurysm growth.

It was difficult to get an overall synthesis for the quality of life domains, as many different tools are used, and different comparison groups are evaluated. By having a recommended tool to measure quality of life (ie. SF-36, as this was the most frequently used), as well as similar comparison groups, it would allow for synthesis across studies and a greater ability to pool results to better support decision making. In addition, the quality of life results should be adjusted for other factors, such as other illness or disease among the population. As these men are 65 years and older, it is likely they are experiencing other factors that may contribute to a decreased quality of life (ie. diabetes, back pain). Longer-term follow-up should also be addressed.

There were a number of studies that reported on surgical outcomes, but only reported on the diameter of the aneurysm at the time of surgical intervention. The research question was to evaluate surgical outcomes in men entering a surveillance programme at the subaneurysmal aortic diameter. It was agreed upon that these studies would not be representative of men originally measuring subaneurysmally. However, as stated in the protocol, if resources permitted, all surgical outcomes regardless of when men entered a screening programme may be evaluated. As there were 79 studies potentially relevant to this question, we did not undertake an evaluation of these studies. If surgical outcomes are of great interest, this is an area that can be further explored. Some of these studies may have followed men entering a surveillance programme subaneurysmally, but it was not clear. This shows the importance of reporting on the date and abdominal aortic measurement at the start of the surveillance, for studies reporting on surgical outcomes.

Interpretation of Evidence: Publication bias

Publication (and location) bias is a potential limitation as grey literature searches were only conducted on one website, 11 full text articles were not located due to their unavailability within the rapid summary time-frame, and 98 studies were excluded based on non-English language. The intent of the review was to identify literature since 1990, but this assessment does not incorporate the totality of the evidence prior to that, although it was deemed a relevant time point as screening programmes did not exist prior to this time.

Limitations of the NOS-Cohort risk of bias tool

There were several limitations to this tool and we modified some of the responses to better suit the included studies (denoted by italics in **Appendix 5**). **Selection:** (1) we added an option of 'not representative'; (2) in studies evaluating growth, all individuals received the exposure (ultrasound screening), making this not applicable as there was no non-exposed cohort; (3) In studies reporting prevalence, exposure was to ultrasound screening, but this was also the assessment of outcome, making these questions somewhat redundant; and (4) this was deemed not applicable for all studies as prevalence would have been present, just not known; quality of life would have been present at the start of a study at some level, even if it was not officially measured; growth would not have been applicable at the start of a study that is measuring growth over time; and progression to surgery and surgery outcomes would not have been applicable at the start of the study. **Comparability.** Articles reporting only prevalence data for the entire cohort would not have any type of comparability, thereby making the 'Comparability' question not applicable. Many studies did not perform any type of comparability, so we added a 'not reported' option. **Outcome.** We added a 'not applicable for cross-sectional prevalence data' option for cohort studies where we used baseline prevalence data, and where follow-up outcomes were not of interest for this rapid evidence summary.

Limitations and strengths of the rapid evidence summary

This rapid evidence summary was conducted over a condensed period of time (19 weeks). We limited our searching to bibliographic databases and only searched one grey literature source. We included studies written in English, however there were 98 studies in other languages (**Appendix 3**).

This rapid evidence summary was guided by a protocol developed *a priori*. We had our search strategies peer-reviewed by another senior information specialist using the PRESS form.[14] We used standard, systematic approaches for study selection, data extraction, and risk of bias assessment. We screened independently at full-text in duplicate. In addition, 100% of the included studies had data extracted and

risk of bias done by one reviewer and verification done by a second reviewer. We also assessed the quality of the body of evidence by adapting the GRADE framework.

In this rapid evidence summary, 11 full-text articles were not retrievable, 98 citations were non-English, and 24 citations were in abstract form. It is unclear at this time how many unique studies those non-retrievable, full-text citations represent and how many would meet our criteria; a brief scan of titles and abstracts leads us to believe that it is likely there are other relevant articles, although it is unclear how many of these would be companion articles to those published in English.

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