

# Tinnitus: assessment and management

## Audiological assessment

*NICE guideline*

*Intervention evidence review*

*September 2019*

*Draft for Consultation*

*This evidence review was developed by  
the National Guideline Centre*



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## **ISBN**

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# 1 <sup>1</sup> Audiological assessment

## 1.1 <sup>2</sup> Review question: what is the clinical and cost effectiveness <sup>3</sup> of audiological assessment for people with tinnitus?

### 1.2 <sup>4</sup> Introduction

<sup>5</sup> People who have tinnitus may be offered one or more tests to assess the function of their  
<sup>6</sup> hearing. Identifying a problem in the hearing system can be helpful to understand why  
<sup>7</sup> someone might have tinnitus, and can inform management decisions, for instance, if a  
<sup>8</sup> hearing aid is suitable or not.

<sup>9</sup> In this review we considered the following tests:

- <sup>10</sup> • **Audiometry** (including pure tone, distraction testing, visual reinforcement, play and  
<sup>11</sup> performance audiometry and speech audiometry) to establish hearing thresholds and  
<sup>12</sup> identify any existing hearing loss. Tinnitus can be associated with sensorineural  
<sup>13</sup> hearing loss for example through exposure to loud noise or aging.
- <sup>14</sup> • **Tympanometry** is used to assess the ear drum and the functioning of the middle ear  
<sup>15</sup> and may help to identify the cause of tinnitus.
- <sup>16</sup> • **Acoustic reflexes** measure the functioning of the middle ear muscles in reaction to  
<sup>17</sup> loud sounds.
- <sup>18</sup> • **Uncomfortable loudness level (ULL)/ Loudness discomfort level (LDL)** measures  
<sup>19</sup> the volume at which external sounds become uncomfortable.
- <sup>20</sup> • **Otoacoustic emissions (OAEs)** assess the functioning of the hair cells in the  
<sup>21</sup> cochlea by measuring sounds produced by the movement of the basilar membrane.

<sup>22</sup> Practice varies considerably across the country. This review has been carried out to identify  
<sup>23</sup> which tests are clinically and cost effective for assessing the hearing system in patients with  
<sup>24</sup> tinnitus.

<sup>25</sup> The review aims to evaluate the clinical and cost-effectiveness of different audiological  
<sup>26</sup> assessments used by different healthcare professionals for the assessment of tinnitus.  
<sup>27</sup> These audiological assessments would be followed up by appropriate interventions for  
<sup>28</sup> tinnitus and the resulting patient outcomes assessed.

### 1.3<sup>29</sup> PICO table

<sup>30</sup> For full details see the review protocol in appendix A.

<sup>31</sup> **Table 1: PICO characteristics of review question**

<b>Population</b>	People presenting to a healthcare setting with tinnitus
<b>Interventions</b>	Audiological assessments: <ul style="list-style-type: none"><li>• Audiometry to assess hearing threshold (e.g. pure tone audiometry, distraction testing, visual reinforcement audiometry, play and performance audiometry, speech audiometry)</li><li>• Tympanometry</li><li>• Acoustic reflexes</li><li>• Uncomfortable loudness levels (ULL)</li><li>• OAEs (TEOAEs, DPOAE, SOAEs)</li></ul>
<b>Comparison</b>	<ul style="list-style-type: none"><li>• No audiological assessment</li></ul>
<b>Outcomes</b>	<ul style="list-style-type: none"><li>• Tinnitus severity (critical)</li></ul>

	<p>Impact of tinnitus (critical):</p> <ul style="list-style-type: none"><li>• Tinnitus distress</li><li>• Tinnitus annoyance</li></ul> <p>Health related QoL(critical):</p> <ul style="list-style-type: none"><li>• QoL (tinnitus)</li><li>• QoL</li></ul> <p>Tinnitus percept (important):</p> <ul style="list-style-type: none"><li>• Tinnitus loudness</li></ul> <p>Other co-occurring complaints (important):</p> <ul style="list-style-type: none"><li>• Depression</li><li>• Anxiety</li><li>• Anxiety and depression</li><li>• Sleep</li></ul> <p>Adverse events (important):</p> <ul style="list-style-type: none"><li>• Safety</li><li>• Tolerability</li><li>• Side effects</li></ul>
<b>Study design</b>	<ul style="list-style-type: none"><li>• Systematic review of RCTs</li><li>• RCT</li><li>• If there is an inadequate amount of RCT data, non-randomised comparative studies will be considered.</li></ul>

## 1.4 1 Clinical evidence

### 1.4.1 2 Included studies

3 No relevant randomised controlled trial evidence comparing audiological assessments with  
4 no audiological assessment were identified. Consequently, non-randomised comparative  
5 studies were also assessed. However, no relevant studies were identified for inclusion.

6 See also the study selection flow chart in appendix C, study evidence tables in appendix D,  
7 forest plots in appendix E and GRADE tables in appendix H.

### 1.4.2 8 Excluded studies

9 See the excluded studies list in appendix J.

## 1.5<sup>10</sup> Economic evidence

### 1.5.11 Included studies

12 No relevant health economic studies were identified.

### 1.5.23 Excluded studies

14 No health economic studies that were relevant to this question were excluded due to  
15 assessment of limited applicability or methodological limitations.

1 See also the health economic study selection flow chart in appendix G.

## 1.6 2 Evidence statements

### 1.6.1 3 Clinical evidence statements

4 • No relevant published evidence was identified.

### 1.6.2 5 Health economic evidence statements

6 • No relevant economic evaluations were identified.

## 1.7 7 The committee's discussion of the evidence

### 1.7.1 8 Interpreting the evidence

#### 1.7.1.1 9 The outcomes that matter most

10 Tinnitus distress, annoyance and tinnitus severity were critical outcomes as they were  
11 thought to be common complaints for those with tinnitus and impact their quality of life.  
12 Quality of life (tinnitus-related) and general quality of life were also critical outcomes due to  
13 their impact on the person with tinnitus.

14 Tinnitus loudness, anxiety, depression, sleep, safety, tolerability and side effects were  
15 thought to be important outcomes.

16 We looked for studies that examined whether audiological assessment with any of these  
17 tests effects the onward management of the person, as measured by the tinnitus related  
18 outcomes above. The hypothesis being that having the results of the tests could allow  
19 clinicians to develop a management plan to provide the most appropriate treatments and  
20 therefore improve outcomes for people compared to people who had not had these tests.

21 There was no evidence for any outcomes.

#### 1.7.1.2 22 The quality of the evidence

23 Randomised controlled trials (RCTs) and systematic reviews of RCTs were searched for and  
24 assessed for eligibility but no relevant RCT evidence was identified which matched the  
25 review protocol. Consequently, non-randomised comparative studies were also searched for  
26 and assessed for eligibility. No relevant non-randomised comparative studies which matched  
27 the protocol were identified.

#### 1.7.1.3 28 Benefits and harms

29 The committee made consensus recommendations based on their expertise.

30 They considered that audiometry was the basis for understanding whether a hearing loss  
31 may be present and maybe contributing to the person's experience of tinnitus. This  
32 information allows clinicians to tailor their further management and therefore should always  
33 be performed. An example of this would be finding that the person has a hearing loss that  
34 can be corrected by hearing aids, which in turn may make their tinnitus less noticeable. This  
35 should have a benefit for the person as long as the tests are tailored to people's' age and  
36 abilities and the results are acted on appropriately.

37 Tympanometry may be used to ascertain for example whether there is a problem with the  
38 middle ear or Eustachian tube that could be causing tinnitus and/or whether there may be a  
39 conductive hearing loss. Further management can be tailored to address these concerns.

1 The committee was not aware of any harms or side effects associated with the use of  
2 audiometry and tympanometry.

3 Uncomfortable loudness level (ULL)/ loudness discomfort level (LDL) tests and acoustic  
4 reflexes were thought to be unpleasant and potentially harmful with some people reporting  
5 anecdotally that the loud sounds made their tinnitus worse. ULL/LDL tests provide  
6 information on the person's dynamic range and this is not particularly valuable in determining  
7 the future management plan for managing the person's tinnitus. ULL/LDLs were considered  
8 by the committee to have low test-retest reliability. Acoustic reflex testing was not considered  
9 to provide any additional information that would help inform the person's management care  
10 plan. The committee decided that these tests should therefore not be recommended.

11 Otoacoustic emissions (OAEs) were not thought to be useful in routine clinical practice for  
12 the investigation of tinnitus, but may be useful occasionally for children when ear-specific  
13 audiometry was not possible. OAEs may be useful in a few cases for adults, for investigation  
14 of objective tinnitus; however this is not likely to change the management of their tinnitus and  
15 are consequently not recommended for routine practice.

16 In summary, the committee considered that for people being seen in audiological or  
17 ENT/audiovestibular medicine services, audiometry should be performed as standard and  
18 tympanometry should be performed where required, whereas acoustic reflexes and ULL/  
19 LDL tests could cause more harm than benefit. OAEs are not normally required.

20

#### **1.7.21 Cost effectiveness and resource use**

22 The tests require specific equipment and some staff time. There were no economic  
23 evaluations available for this review question. The view of the committee was that  
24 audiometry and tympanometry do aid in the management of people with tinnitus as they can  
25 identify whether a hearing loss or middle ear/ Eustachian tube dysfunction is present. As  
26 audiological/ENT centres already have audiometers and providing a hearing test is routine in  
27 current practice, the recommendation would not have a significant resource impact.  
28 Tympanometry should be performed for the group where a conductive loss is suspected or  
29 for investigation of the middle ear. As this population would be expected to be relatively small  
30 and equipment is already available, there is not expected to be a substantial resource  
31 impact.

32 LDLs, ULLs, OAEs and acoustic reflexes were not recommended. The view of the committee  
33 was that these measures would not result in a change in the management of people with  
34 tinnitus. With no expected change in quality of life, these tests would not be cost-effective.  
35 The recommendation not to offer these tests would therefore result in modest cost savings in  
36 those places that do currently offer these tests.

#### **1.7.37 Other factors the committee took into account**

38 The committee did not expect the recommendation on audiometry to change practice as they  
39 believe that this is performed for everybody with tinnitus referred at the moment. Some  
40 places may perform tympanometry and acoustic reflexes as standard and may be able to  
41 stop offering acoustic reflexes and reduce the numbers that are offered tympanometry. ULL/  
42 LDL may only be performed in a few centres currently and these should stop offering this test  
43 as routine for people with tinnitus. Some people, particularly those with hyperacusis find the  
44 loud noises uncomfortable and in some cases report that they can exacerbate their tinnitus.

45 Audiometry should be tailored to the age and ability of the people.



- 1 The NICE guideline on hearing loss (NG98) covers audiological assessment for people
- 2 suspected of having a hearing loss in more detail <sup>4</sup>. NG98 also makes recommendation on
- 3 managing hearing loss with hearing aids.
- 4

## 1 References

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- 18

# 1 Appendices

## 2 Appendix A: Review protocols

3 Table 2: Review protocol: What is the clinical and cost effectiveness of audiological  
4 assessment for people with tinnitus?

ID	Field	Content
0.	PROSPERO registration number	Not registered
1.	Review title	The clinical and cost effectiveness of audiological assessment for people with tinnitus
2.	Review question	What is the clinical and cost effectiveness of audiological assessment for people with tinnitus?
3.	Objective	The review aims to evaluate the clinical effectiveness and cost-effectiveness of different audiological assessments that are utilised by different healthcare professionals for the assessment of tinnitus. These audiological assessments would be followed up by appropriate treatments for tinnitus and the resulting patient outcomes assessed.
4.	Searches	<p>The following databases will be searched:</p> <ul style="list-style-type: none"> <li>• Cochrane Central Register of Controlled Trials (CENTRAL)</li> <li>• Cochrane Database of Systematic Reviews (CDSR)</li> <li>• Embase</li> <li>• MEDLINE</li> <li>• CINAHL, Current Nursing and Allied Health Literature</li> </ul> <p>Searches will be restricted by:</p> <ul style="list-style-type: none"> <li>• English language</li> <li>• Human studies</li> </ul>

		<ul style="list-style-type: none"> <li>Letters and comments are excluded.</li> </ul> <p>Other searches:</p> <ul style="list-style-type: none"> <li>Inclusion lists of relevant systematic reviews will be checked by the reviewer.</li> </ul> <p>The searches may be re-run 6 weeks before final committee meeting and further studies retrieved for inclusion if relevant.</p> <p>The full search strategies will be published in the final review</p>
5.	Condition or domain being studied	Tinnitus
6.	Population	<p>Inclusion:</p> <p>People presenting to a healthcare setting with tinnitus</p> <p>Exclusion: None</p>
7.	Intervention/Exposure/Test	<p>Audiological assessments:</p> <ul style="list-style-type: none"> <li>Audiometry to assess hearing threshold (e.g. pure tone audiometry, distraction testing, visual reinforcement audiometry, play and performance audiometry, speech audiometry)</li> <li>Tympanometry</li> <li>Acoustic reflexes</li> <li>Uncomfortable loudness levels (ULL)</li> <li>OAEs (TEOAEs, DPOAE, SOAEs)</li> </ul>
8.	Comparator/Reference standard/Confounding factors	<ul style="list-style-type: none"> <li>No audiological assessment</li> </ul>
9.	Types of study to be included	<ul style="list-style-type: none"> <li>Systematic reviews</li> <li>RCTs</li> <li>If there is an inadequate amount of RCT data, non-randomised comparative studies will be considered.</li> </ul>

10.	Other exclusion criteria	<ul style="list-style-type: none"> <li>• Non-English language studies</li> <li>• Studies will only be included if they report one or more of the outcomes listed above</li> <li>• Descriptive (non-comparative) studies will be excluded</li> </ul>
11.	Context	N/A
12.	Primary outcomes (critical outcomes)	<ul style="list-style-type: none"> <li>• Tinnitus severity</li> </ul> <p>Impact of tinnitus:</p> <ul style="list-style-type: none"> <li>• Tinnitus distress</li> <li>• Tinnitus annoyance</li> </ul> <p>Health related QoL:</p> <ul style="list-style-type: none"> <li>• QoL (tinnitus)</li> <li>• QoL</li> </ul>
13.	Secondary outcomes (important outcomes)	<p>Tinnitus percept:</p> <ul style="list-style-type: none"> <li>• Tinnitus loudness</li> </ul> <p>Other co-occurring complaints</p> <ul style="list-style-type: none"> <li>• Depression</li> <li>• Anxiety</li> <li>• Anxiety and depression</li> <li>• Sleep</li> </ul> <p>Adverse events</p> <ul style="list-style-type: none"> <li>• Safety</li> <li>• Tolerability</li> <li>• Side effects</li> </ul>
14.	Data extraction (selection and coding)	<p>EndNote will be used for reference management, sifting, citations and bibliographies. Titles and/or abstracts of studies retrieved using the search strategy and those from additional sources will be screened for inclusion.</p> <p>The full text of potentially eligible studies will be retrieved and will be assessed for eligibility in line with the criteria outlined above.</p> <p>10% of the abstracts will be reviewed by two reviewers, with any disagreements resolved by discussion or, if necessary, a third independent reviewer.</p> <p>An in-house developed database; EviBase, will</p>

		<p>be used for data extraction. A standardised form is followed to extract data from studies (see <a href="#">Developing NICE guidelines: the manual</a> section 6.4) and for undertaking assessment of study quality. Summary evidence tables will be produced including information on: study setting; study population and participant demographics and baseline characteristics; details of the intervention and control interventions; study methodology' recruitment and missing data rates; outcomes and times of measurement; critical appraisal ratings.</p> <p>A second reviewer will quality assure the extracted data. Discrepancies will be identified and resolved through discussion (with a third reviewer where necessary).</p>
15.	Risk of bias (quality) assessment	<p>Risk of bias will be assessed using the appropriate checklist as described in <a href="#">Developing NICE guidelines: the manual</a>.</p> <p><a href="#">For Intervention reviews the following checklist will be used according to study design being assessed:</a></p> <ul style="list-style-type: none"> <li>• <a href="#">Systematic reviews: Risk of Bias in Systematic Reviews (ROBIS)</a></li> <li>• <a href="#">Randomised Controlled Trial: Cochrane RoB (2.0)</a></li> </ul> <p>Disagreements between the review authors over the risk of bias in particular studies will be resolved by discussion, with involvement of a third review author where necessary.</p>
16.	Strategy for data synthesis	<p>Where possible, data will be meta-analysed. Pairwise meta-analyses will be performed using Cochrane Review Manager (RevMan5) to combine the data given in all studies for each of the outcomes stated above. A fixed effect meta-analysis, with weighted mean differences for continuous outcomes and risk ratios for binary outcomes will be used, and 95% confidence intervals will be calculated for each outcome.</p> <p>Heterogeneity between the studies in effect measures will be assessed using the <math>I^2</math> statistic and visually inspected. We will consider an <math>I^2</math> value greater than 50% indicative of substantial heterogeneity. Sensitivity analyses will be</p>

		<p>conducted based on pre-specified subgroups using stratified meta-analysis to explore the heterogeneity in effect estimates. If this does not explain the heterogeneity, the results will be presented using random-effects.</p> <p>GRADE pro will be used to assess the quality of each outcome, taking into account individual study quality and the meta-analysis results. The 4 main quality elements (risk of bias, indirectness, inconsistency and imprecision) will be appraised for each outcome.</p> <p>Publication bias is tested for when there are more than 5 studies for an outcome. Other bias will only be taken into consideration in the quality assessment if it is apparent.</p> <p>Where meta-analysis is not possible, data will be presented and quality assessed individually per outcome.</p> <p>If sufficient data is available to make a network of treatments, WinBUGS will be used for network meta-analysis.</p>		
17.	Analysis of sub-groups	<ul style="list-style-type: none"> <li>• People with learning disability or cognitive impairment</li> <li>• Hyperacusis</li> </ul>		
18.	Type and method of review	<input checked="" type="checkbox"/> Intervention <input type="checkbox"/> Diagnostic <input type="checkbox"/> Prognostic <input type="checkbox"/> Qualitative <input type="checkbox"/> Epidemiologic <input type="checkbox"/> Service Delivery <input type="checkbox"/> Other (please specify)		
19.	Language	English		
20.	Country	England		
21.	Anticipated or actual start date	27/06/18		
22.	Anticipated completion date	11/03/20		
23.	Stage of review at time of this submission	Review stage	Started	Completed

		Preliminary searches	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Piloting of the study selection process	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Formal screening of search results against eligibility criteria	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Data extraction	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Risk of bias (quality) assessment	<input type="checkbox"/>	<input checked="" type="checkbox"/>
		Data analysis	<input type="checkbox"/>	<input checked="" type="checkbox"/>
24.	Named contact	<p>5a. Named contact National Guideline Centre</p> <p>5b Named contact e-mail Tinnitus@nice.org.uk</p> <p>5e Organisational affiliation of the review National Institute for Health and Care Excellence (NICE) and the National Guideline Centre</p>		
25.	Review team members	<p>From the National Guideline Centre:</p> <ul style="list-style-type: none"> <li>• Dr Jennifer Hill [Guideline lead]</li> <li>• Ms Sedina Lewis/Ms Julie Neilson [Senior systematic reviewers]</li> <li>• Dr Richard Clubbe [Systematic reviewer]</li> <li>• Mr David Wonderling [Health economist lead]</li> <li>• Mr Emtiyaz Chowdhury [Health economist]</li> </ul>		



		<ul style="list-style-type: none"> <li>• Ms Jill Cobb [Information specialist]</li> <li>• Dr Giulia Zuodar [Project manager]</li> </ul>
26.	Funding sources/sponsor	This systematic review is being completed by the National Guideline Centre which receives funding from NICE.
27.	Conflicts of interest	All guideline committee members and anyone who has direct input into NICE guidelines (including the evidence review team and expert witnesses) must declare any potential conflicts of interest in line with NICE's code of practice for declaring and dealing with conflicts of interest. Any relevant interests, or changes to interests, will also be declared publicly at the start of each guideline committee meeting. Before each meeting, any potential conflicts of interest will be considered by the guideline committee Chair and a senior member of the development team. Any decisions to exclude a person from all or part of a meeting will be documented. Any changes to a member's declaration of interests will be recorded in the minutes of the meeting. Declarations of interests will be published with the final guideline.
28.	Collaborators	Development of this systematic review will be overseen by an advisory committee who will use the review to inform the development of evidence-based recommendations in line with section 3 of <a href="#">Developing NICE guidelines: the manual</a> . Members of the guideline committee are available on the NICE website: [NICE guideline webpage].
29.	Other registration details	N/A
30.	Reference/URL for published protocol	N/A
31.	Dissemination plans	<p>NICE may use a range of different methods to raise awareness of the guideline. These include standard approaches such as:</p> <ul style="list-style-type: none"> <li>• notifying registered stakeholders of publication</li> <li>• publicising the guideline through NICE's newsletter and alerts</li> <li>• issuing a press release or briefing as appropriate, posting news articles on the NICE website, using social media channels, and publicising the guideline within NICE.</li> </ul>

32.	Keywords	Tinnitus, audiological assessment, audiology
33.	Details of existing review of same topic by same authors	N/A
34.	Current review status	<input type="checkbox"/> Ongoing <input checked="" type="checkbox"/> Completed but not published <input type="checkbox"/> Completed and published <input type="checkbox"/> Completed, published and being updated <input type="checkbox"/> Discontinued
35..	Additional information	N/A
36.	Details of final publication	<a href="http://www.nice.org.uk">www.nice.org.uk</a>

1 **Table 3: Health economic review protocol**

Review question	All questions – health economic evidence
<b>Objectives</b>	To identify health economic studies relevant to any of the review questions.
<b>Search criteria</b>	<ul style="list-style-type: none"> <li>• Populations, interventions and comparators must be as specified in the clinical review protocol above.</li> <li>• Studies must be of a relevant health economic study design (cost–utility analysis, cost-effectiveness analysis, cost–benefit analysis, cost–consequences analysis, comparative cost analysis).</li> <li>• Studies must not be a letter, editorial or commentary, or a review of health economic evaluations. (Recent reviews will be ordered although not reviewed. The bibliographies will be checked for relevant studies, which will then be ordered.)</li> <li>• Unpublished reports will not be considered unless submitted as part of a call for evidence.</li> <li>• Studies must be in English.</li> </ul>
<b>Search strategy</b>	A health economic study search will be undertaken using population-specific terms and a health economic study filter – see appendix B below.
<b>Review strategy</b>	<p>Studies not meeting any of the search criteria above will be excluded. Studies published before 2003, abstract-only studies and studies from non-OECD countries or the USA will also be excluded.</p> <p>Each remaining study will be assessed for applicability and methodological limitations using the NICE economic evaluation checklist which can be found in appendix H of Developing NICE guidelines: the manual (2014).<sup>3</sup></p> <p><b>Inclusion and exclusion criteria</b></p> <ul style="list-style-type: none"> <li>• If a study is rated as both ‘Directly applicable’ and with ‘Minor limitations’ then it will be included in the guideline. A health economic evidence table will be completed and it will be included in the health economic evidence profile.</li> <li>• If a study is rated as either ‘Not applicable’ or with ‘Very serious limitations’ then it will usually be excluded from the guideline. If it is excluded then a health economic evidence table will not be completed and it will not be included in the health</li> </ul>

economic evidence profile.

- If a study is rated as 'Partially applicable', with 'Potentially serious limitations' or both then there is discretion over whether it should be included.

#### **Where there is discretion**

The health economist will make a decision based on the relative applicability and quality of the available evidence for that question, in discussion with the guideline committee if required. The ultimate aim is to include health economic studies that are helpful for decision-making in the context of the guideline and the current NHS setting. If several studies are considered of sufficiently high applicability and methodological quality that they could all be included, then the health economist, in discussion with the committee if required, may decide to include only the most applicable studies and to selectively exclude the remaining studies. All studies excluded on the basis of applicability or methodological limitations will be listed with explanation in the excluded health economic studies appendix below.

The health economist will be guided by the following hierarchies.

#### *Setting:*

- UK NHS (most applicable).
- OECD countries with predominantly public health insurance systems (for example, France, Germany, Sweden).
- OECD countries with predominantly private health insurance systems (for example, Switzerland).
- Studies set in non-OECD countries or in the USA will be excluded before being assessed for applicability and methodological limitations.

#### *Health economic study type:*

- Cost–utility analysis (most applicable).
- Other type of full economic evaluation (cost–benefit analysis, cost-effectiveness analysis, cost–consequences analysis).
- Comparative cost analysis.
- Non-comparative cost analyses including cost-of-illness studies will be excluded before being assessed for applicability and methodological limitations.

#### *Year of analysis:*

- The more recent the study, the more applicable it will be.
- Studies published in 2003 or later but that depend on unit costs and resource data entirely or predominantly from before 2003 will be rated as 'Not applicable'.
- Studies published before 2003 will be excluded before being assessed for applicability and methodological limitations.

#### *Quality and relevance of effectiveness data used in the health economic analysis:*

- The more closely the clinical effectiveness data used in the health economic analysis match with the outcomes of the studies included in the clinical review the more useful the analysis will be for decision-making in the guideline.

## **1 Appendix B: Literature search strategies**

2 The literature searches for this review are detailed below and complied with the methodology  
3 outlined in Developing NICE guidelines: the manual.<sup>3</sup>

4 *For more detailed information, please see the Methodology Review.*

### **B.1.5 Clinical search literature search strategy**

6 Searches were constructed using a PICO framework where population (P) terms were  
7 combined with Intervention (I) and in some cases Comparison (C) terms. Outcomes (O) are

- 1 rarely used in search strategies for interventions as these concepts may not be well
- 2 described in title, abstract or indexes and therefore difficult to retrieve. Search filters were
- 3 applied to the search where appropriate.

#### 4 Table 4: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline (OVID)	1946 – 02 April 2019	Exclusions
Embase (OVID)	1974 – 02 April 2019	Exclusions
The Cochrane Library (Wiley)	Cochrane Reviews to 2019 Issue 4 of 12 CENTRAL to 2019 Issue 4 of 12 DARE, and NHSEED to 2015 Issue 2 of 4 HTA to 2016 Issue 4 of 4	None
CINAHL, Current Nursing and Allied Health Literature (EBSCO)	Inception – 02 April 2019	Exclusions

#### 5 Medline (Ovid) search terms

1.	Tinnitus/
2.	tinnit*.ti,ab.
3.	1 or 2
4.	letter/
5.	editorial/
6.	news/
7.	exp historical article/
8.	Anecdotes as Topic/
9.	comment/
10.	case report/
11.	(letter or comment*).ti.
12.	or/4-11
13.	randomized controlled trial/ or random*.ti,ab.
14.	12 not 13
15.	animals/ not humans/
16.	exp Animals, Laboratory/
17.	exp Animal Experimentation/
18.	exp Models, Animal/
19.	exp Rodentia/
20.	(rat or rats or mouse or mice).ti.
21.	or/14-20
22.	3 not 21
23.	limit 22 to English language

#### 6 Embase (Ovid) search terms

1.	tinnitus/
2.	tinnit*.ti,ab.
3.	1 or 2

4.	letter.pt. or letter/
5.	note.pt.
6.	editorial.pt.
7.	Case report/ or Case study/
8.	(letter or comment*).ti.
9.	or/4-8
10.	randomized controlled trial/ or random*.ti,ab.
11.	9 not 10
12.	animal/ not human/
13.	Nonhuman/
14.	exp Animal Experiment/
15.	exp Experimental animal/
16.	Animal model/
17.	exp Rodent/
18.	(rat or rats or mouse or mice).ti.
19.	or/11-18
20.	3 not 19
21.	limit 20 to English language

#### 1 Cochrane Library (Wiley) search terms

#1.	MeSH descriptor: [Tinnitus] explode all trees
#2.	tinnit*:ti,ab
#3.	#1 or #2

#### 2 CINAHL (EBSCO) search terms

S1.	(MH "Tinnitus")
S2.	(MH "Tinnitus Retraining Therapy")
S3.	tinnit*
S4.	S1 OR S2 OR S3
S5.	PT anecdote or PT audiovisual or PT bibliography or PT biography or PT book or PT book review or PT brief item or PT cartoon or PT commentary or PT computer program or PT editorial or PT games or PT glossary or PT historical material or PT interview or PT letter or PT listservs or PT masters thesis or PT obituary or PT pamphlet or PT pamphlet chapter or PT pictorial or PT poetry or PT proceedings or PT "questions and answers" or PT response or PT software or PT teaching materials or PT website
S6.	S4 NOT S5

## B.2.3 Health Economics literature search strategy

4 Health economic evidence was identified by conducting a broad search relating to the  
5 tinnitus population in NHS Economic Evaluation Database (NHS EED – this ceased to be  
6 updated after March 2015) and the Health Technology Assessment database (HTA) with no  
7 date restrictions. NHS EED and HTA databases are hosted by the Centre for Research and  
8 Dissemination (CRD). Additional searches were run on Medline and Embase for health  
9 economics and quality of life studies

#### 10 Table 5: Database date parameters and filters used

Database	Dates searched	Search filter used
Medline	2002 – 02 March 2019	Exclusions

Database	Dates searched	Search filter used
		Health economics studies Quality of life studies
Embase	2002 – 02 March 2019	Exclusions Health economics studies Quality of life studies
Centre for Research and Dissemination (CRD)	HTA - Inception – 31 Mar 2018 NHSEED - Inception to March 2015	None

## 1 Medline (Ovid) search terms

1.	Tinnitus/
2.	tinnit*.ti,ab.
3.	1 or 2
4.	letter/
5.	editorial/
6.	news/
7.	exp historical article/
8.	Anecdotes as Topic/
9.	comment/
10.	case report/
11.	(letter or comment*).ti.
12.	or/4-11
13.	randomized controlled trial/ or random*.ti,ab.
14.	12 not 13
15.	animals/ not humans/
16.	exp Animals, Laboratory/
17.	exp Animal Experimentation/
18.	exp Models, Animal/
19.	exp Rodentia/
20.	(rat or rats or mouse or mice).ti.
21.	or/14-20
22.	3 not 21
23.	limit 22 to English language
24.	Economics/
25.	Value of life/
26.	exp "Costs and Cost Analysis"/
27.	exp Economics, Hospital/
28.	exp Economics, Medical/
29.	Economics, Nursing/
30.	Economics, Pharmaceutical/
31.	exp "Fees and Charges"/
32.	exp Budgets/
33.	budget*.ti,ab.
34.	cost*.ti.

35.	(economic* or pharmaco?economic*).ti.
36.	(price* or pricing*).ti,ab.
37.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
38.	(financ* or fee or fees).ti,ab.
39.	(value adj2 (money or monetary)).ti,ab.
40.	or/24-39
41.	quality-adjusted life years/
42.	sickness impact profile/
43.	(quality adj2 (wellbeing or well being)).ti,ab.
44.	sickness impact profile.ti,ab.
45.	disability adjusted life.ti,ab.
46.	(qal* or qtime* or qwb* or daly*).ti,ab.
47.	(euroqol* or eq5d* or eq 5*).ti,ab.
48.	(qol* or hqj* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
49.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
50.	(hui or hui1 or hui2 or hui3).ti,ab.
51.	(health* year* equivalent* or hye or hyes).ti,ab.
52.	discrete choice*.ti,ab.
53.	rosser.ti,ab.
54.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
55.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
56.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
57.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
58.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.
59.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
60.	or/41-59
61.	23 and (40 or 60)

## 1 Embase (Ovid) search terms

1.	tinnitus/
2.	tinnit*.ti,ab.
3.	1 or 2
4.	letter.pt. or letter/
5.	note.pt.
6.	editorial.pt.
7.	Case report/ or Case study/
8.	(letter or comment*).ti.
9.	or/4-8
10.	randomized controlled trial/ or random*.ti,ab.
11.	9 not 10
12.	animal/ not human/
13.	Nonhuman/
14.	exp Animal Experiment/

15.	exp Experimental animal/
16.	Animal model/
17.	exp Rodent/
18.	(rat or rats or mouse or mice).ti.
19.	or/11-18
20.	3 not 19
21.	health economics/
22.	exp economic evaluation/
23.	exp health care cost/
24.	exp fee/
25.	budget/
26.	funding/
27.	budget*.ti,ab.
28.	cost*.ti.
29.	(economic* or pharmaco?economic*).ti.
30.	(price* or pricing*).ti,ab.
31.	(cost* adj2 (effective* or utilit* or benefit* or minimi* or unit* or estimat* or variable*)).ab.
32.	(financ* or fee or fees).ti,ab.
33.	(value adj2 (money or monetary)).ti,ab.
34.	or/21-33
35.	quality adjusted life year/
36.	"quality of life index"/
37.	short form 12/ or short form 20/ or short form 36/ or short form 8/
38.	sickness impact profile/
39.	(quality adj2 (wellbeing or well being)).ti,ab.
40.	sickness impact profile.ti,ab.
41.	disability adjusted life.ti,ab.
42.	(qal* or qtime* or qwb* or daly*).ti,ab.
43.	(euroqol* or eq5d* or eq 5*).ti,ab.
44.	(qol* or hql* or hqol* or h qol* or hrqol* or hr qol*).ti,ab.
45.	(health utility* or utility score* or disutilit* or utility value*).ti,ab.
46.	(hui or hui1 or hui2 or hui3).ti,ab.
47.	(health* year* equivalent* or hye or hyes).ti,ab.
48.	discrete choice*.ti,ab.
49.	rosser.ti,ab.
50.	(willingness to pay or time tradeoff or time trade off or tto or standard gamble*).ti,ab.
51.	(sf36* or sf 36* or short form 36* or shortform 36* or shortform36*).ti,ab.
52.	(sf20 or sf 20 or short form 20 or shortform 20 or shortform20).ti,ab.
53.	(sf12* or sf 12* or short form 12* or shortform 12* or shortform12*).ti,ab.
54.	(sf8* or sf 8* or short form 8* or shortform 8* or shortform8*).ti,ab.



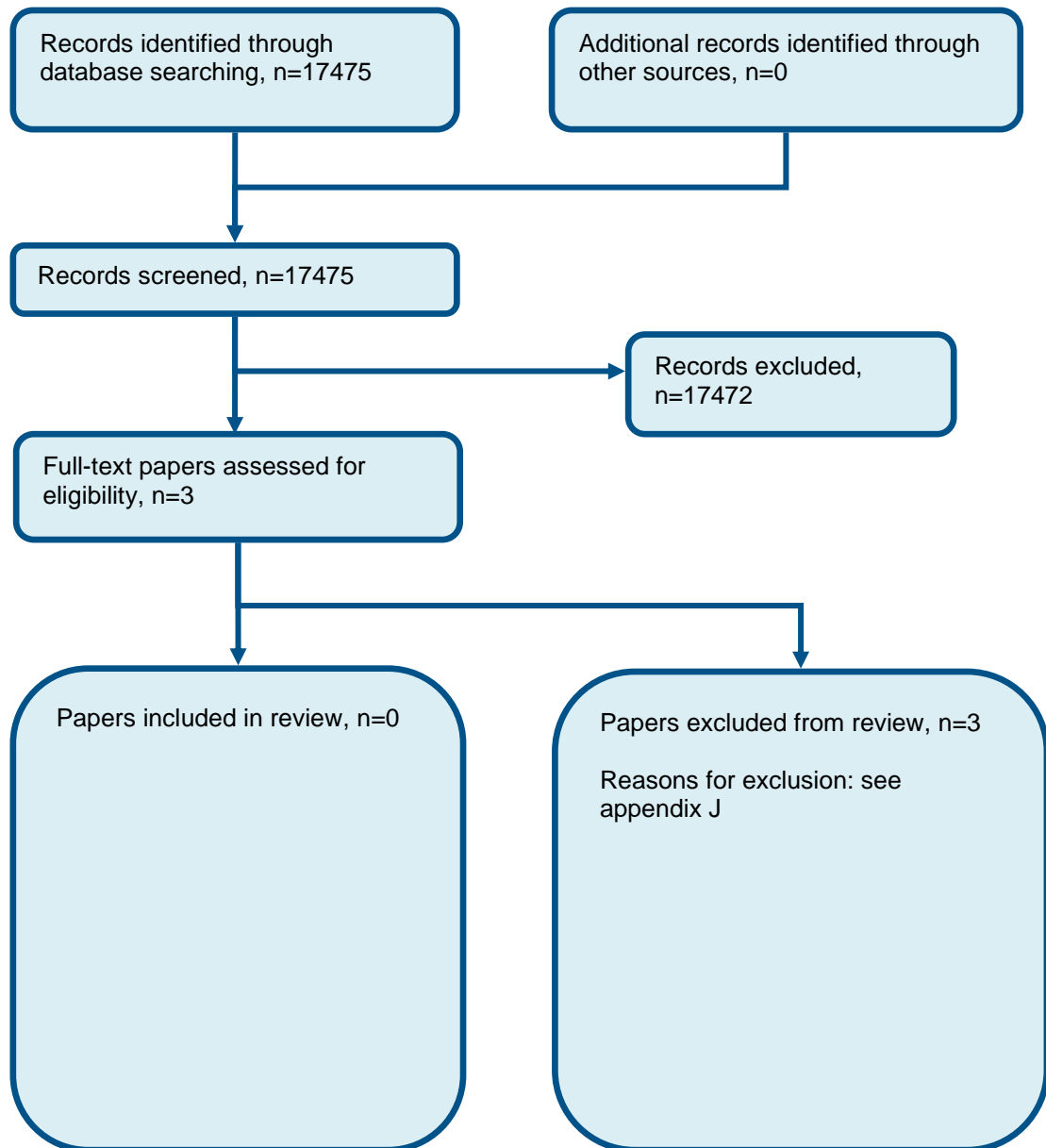
55.	(sf6* or sf 6* or short form 6* or shortform 6* or shortform6*).ti,ab.
56.	or/35-55
57.	20 and (34 or 56)
58.	limit 57 to English language

**1 NHS EED and HTA (CRD) search terms**

#1.	MeSH DESCRIPTOR Tinnitus EXPLODE ALL TREES
#2.	(tinnit*)
#3.	#1 OR #2

## 1 Appendix C: Clinical evidence selection

Figure 1: Flow chart of clinical study selection for the review of audiological assessment



2

# 1 **Appendix D: Clinical evidence tables**

2 None.

3

# 1 **Appendix E: Forest plots**

2 None.

3

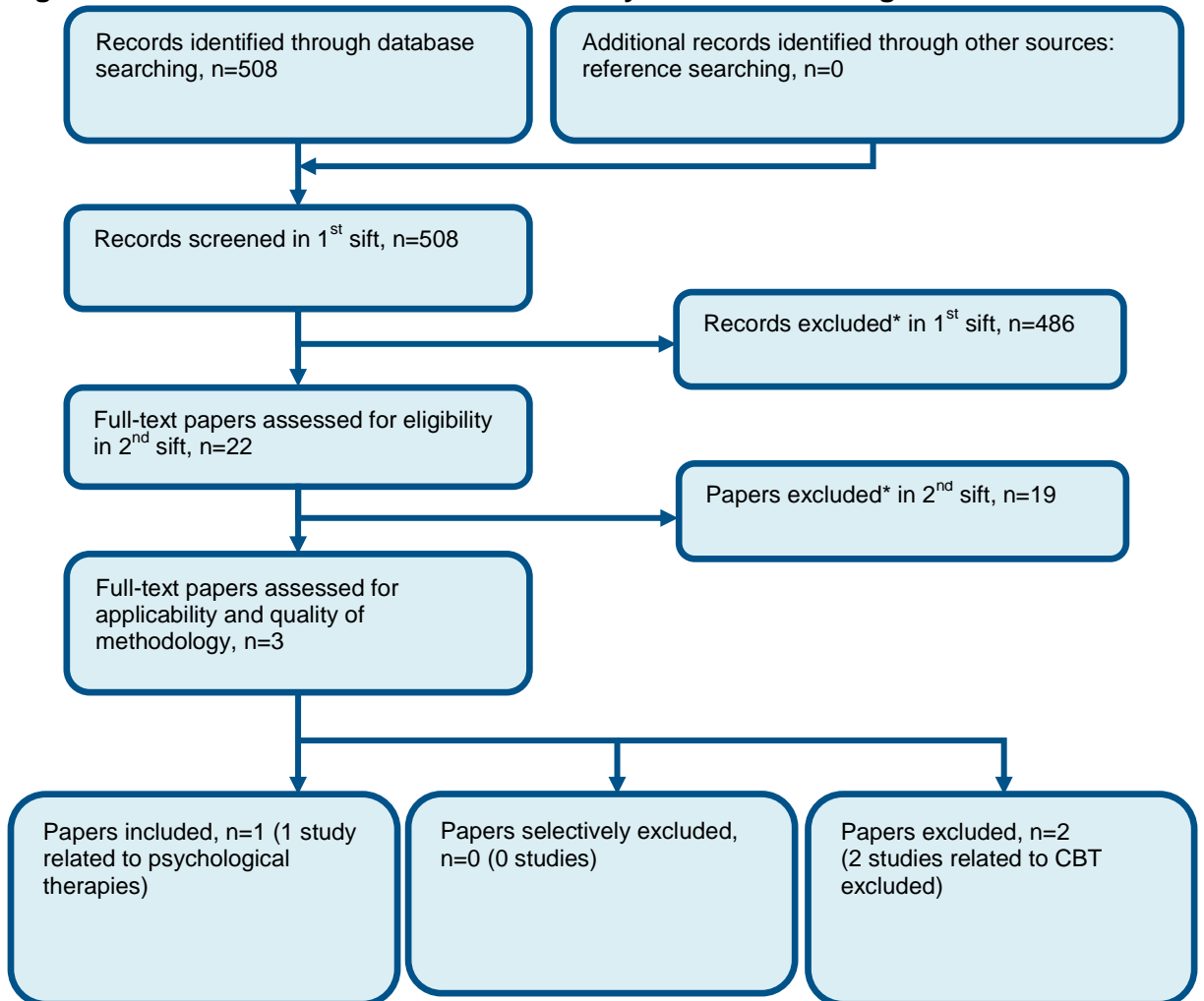
1 **Appendix F: GRADE tables**

2 None.

3

# 1 Appendix G: Health economic evidence selection

2 **Figure 2: Flow chart of health economic study selection for the guideline**



\* Non-relevant population, intervention, comparison, design or setting; non-English language

3

## 1 **Appendix H: Health economic evidence tables**

2 None.

# 1 Appendix I: Excluded studies

## 2 I.1 Excluded clinical studies

3 **Table 6: Studies excluded from the clinical review**

Reference	Reason for exclusion
Kim 2017 <sup>2</sup>	Incorrect study design: cross-sectional study
Karlsrose 2001 <sup>1</sup>	No relevant outcome data
Zaugg 2016 <sup>5</sup>	Incorrect study design: non-randomised study

## 4 I.2 Excluded health economic studies

5 None.