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Vocal tasks for acoustic and auditory perceptual analysis for discriminating individuals with and without voice disorders: A systematic review protocol

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SCHOLARONE™
Manuscripts

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3 **Vocal tasks for acoustic and auditory perceptual analysis for discriminating individuals**
4 **with and without voice disorders: A systematic review protocol**
5

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21 **ABSTRACT**
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23 ***Objective:***
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25 The primary objective of the present systematic review is to:
26

27 1) identify the current vocal tasks being used for acoustic and/or auditory perceptual analysis
28 to differentiate between individuals with and without voice disorders
29

30 The secondary objectives are to:
31

32 2) evaluate the evidence of the sensitivity, specificity and accuracy of those vocal tasks for
33 acoustic and/or auditory perceptual analysis in discriminating the individuals with voice
34 disorders from those without.
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36 3) compare the values between the vocal tasks in discriminating individuals with voice
37 disorders from those without.
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40 ***Method and analysis:***
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42 We search the following electronic databases: MEDLINE, EMBASE, CINAHL, Scopus, Web of
43 Science Core Collection, PubMed Central, and Google Scholar. Grey literature searches will
44 include ProQuest Dissertations and Theses, ClinicalTrials.gov, and the Cochrane Register of
45 Controlled Trials. Websites of professional organizations and textbooks will be hand searched
46 for relevant information related to the research question. Study screening, selection and data
47 extraction will be conducted independently by two reviewers. Any disagreements will be
48 resolved by discussion or by involving a third reviewer.
49

50 The methodological quality of the included studies will be appraised using the relevant Critical
51 Appraisal Tools by JBI. The clinical guidelines and recommendations for voice assessment by
52 professional bodies will be appraised using the RIGHT checklist. The findings will be presented
53 in the form of an information matrix with the tasks identified tabulated against the nature of
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3 the task, dimensions being tested, and their accuracy, sensitivity, and specificity in identifying
4 individuals with voice problems.
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6 ***Ethics and dissemination:***

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8 Formal ethics approval is not required. The findings will be presented at national and
9 international conferences and published in a peer-reviewed journal.
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12 **PROSPERO registration number:** PROSPERO 2023 CRD42023431634
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14 15 16 **Strengths and limitations of this study**

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- 19 • The systematic review will follow a robust procedure to identify the tasks from
20 scientific articles, textbooks, as well as recommendations and guidelines by
21 professional organizations for otorhinolaryngologists and speech-language
22 pathologists.
23
 - 24 • This systematic review will identify the different tasks being used for acoustic and/or
25 auditory perceptual analysis to differentiate individuals with voice disorders from
26 those without. Further, it will provide evidence of the sensitivity, specificity and
27 accuracy of those vocal tasks.
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 - 29 • The findings of the review will be presented as an information matrix that will be a
30 useful evidence-based guide for task selection in acoustic and/or auditory perceptual
31 analysis.
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 - 33 • Only articles written in the English language will be included in the review.
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38 **INTRODUCTION**

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40 An individual is suspected to have a voice disorder when their voice pitch, quality or
41 loudness differs compared to others of the same age, gender, ethnic background, or
42 geographical location.¹ The presence of voice disorders can impact communication and have
43 a negative impact on the overall well-being of the individual and their quality of life.^{2,3} Delays
44 in referrals and increased wait times increase the burden on healthcare systems whilst early
45 assessment, diagnosis and access to treatment can help in reducing healthcare costs.⁴
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49 Research in voice and laryngology has recommended multidimensional assessments
50 using a comprehensive test battery when assessing a voice disorder. These include case
51 history, laryngeal imaging, auditory-perceptual evaluation, acoustic analysis, aerodynamic
52 analysis, and patient-reported outcome measures regarding the impact of the voice disorder
53 on the patient's life.⁵⁻⁷
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57 Acoustic analysis of voice provides objective or quantifiable measures in relation to
58 the vocal function, loudness, pitch, and quality. It includes non-invasive procedures and are
59 commonly used in clinical assessment for detecting the presence or absence of a voice
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3 disorder.⁶ Protocols are available for functional assessment of voice⁵ while recent consensus
4 documents provide specific recommendations on data acquisition, technical specifications,
5 examination procedures and tasks that can be used for acoustic analysis.⁷ Guidelines based
6 on scientific literature have also been suggested for recording and analysis in specific
7 conditions such as dysarthria of movement disorders⁸ and muscle tension dysphonia.⁹
8 Studies on acoustic analysis of voice have proposed using wide variety of tasks ranging from
9 sustained phonation, variations in sustained phonation with respect to pitch and intensity,
10 reading sentences or passages, or counting numbers^{5,7,8,10}. Auditory perceptual evaluation of
11 voice is often considered the gold standard and refers to the method of rating a voice and its
12 associated qualities by listening to it. Auditory perceptual evaluation is subjective and
13 influenced by several factors related to the listener, such as their experience, bias, stimuli,
14 and rating procedure being used¹¹⁻¹³.

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21 Studies have been carried out to identify the optional tasks for the acoustic and/or
22 auditory perceptual analysis of voice.¹⁴⁻¹⁶ However, we do not have a comprehensive
23 understanding about the vocal tasks being used for acoustic and/or auditory perceptual
24 analysis to differentiate between individuals with and without voice disorders. A preliminary
25 search was conducted on Medline, PROSPERO, JBI Evidence synthesis and Google Scholar and
26 no existing reviews or registered protocols on tasks for acoustic and/or auditory perceptual
27 analysis were identified.

31 **Review questions**

32
33 What are the current vocal tasks being used for acoustic and/or auditory perceptual
34 analysis to differentiate between individuals with and without voice disorders?

35
36
37 What is the available evidence of the sensitivity, specificity, and accuracy of those vocal tasks
38 for acoustic and/or auditory perceptual analysis in discriminating the individuals with and
39 without voice disorders? Are there differences in the vocal task values between individuals
40 with and without voice disorders?
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45 **METHODS AND ANALYSIS**

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47 The systematic review protocol follows methodology suggested by the Preferred Reporting
48 Items for Systematic review and Meta-Analysis Protocols (PRISMA-P).¹⁷ The completed
49 PRISMA-P checklist has been provided. The protocol has been published in PROSPERO
50 International Prospective Register of Systematic Reviews database PROSPERO 2023
51 CRD42023431634. The final review will be reported as per the Preferred Reporting Items for
52 Systematic review and Meta-Analysis (PRISMA) statement.¹⁸
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56 **Study selection Criteria**

57 *Participants*
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3 Studies comparing individuals with and without voice disorders using acoustic and/or
4 auditory perceptual evaluation of voice will be included. No limits will be placed upon neither
5 the age range, gender, or language of the participants nor their geographical region or
6 ethnicity.
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10 *Concept*

11 *Inclusion*

12 Studies in human subjects exploring vocal tasks for acoustic and/or auditory perceptual
13 analysis of voice across clinical and laboratory-based settings will be considered. Only studies
14 that compare individuals with and without voice problems will be considered. Only studies
15 that have performed a statistical analysis, such as sensitivity or specificity, to discriminate
16 between the two groups will be included.
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20 *Exclusion*

21 Studies using animal models involving users of alaryngeal speech, artificial or machine-
22 generated tones will not be included. Studies evaluating effectiveness of any interventions or
23 therapeutic approaches will not be included. Studies in individuals with any speech sound
24 disorders or articulation disorders will not be included.
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29 *Study design*

30 No filters for study design will be used.
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33 *Context*

34 The review will include relevant data from all geographical locations and settings. All studies
35 published in the English language from 1930 onwards will be included. The year 1930 was
36 selected as it is the year in which formal studies on voice were first reported ⁶.
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40 *Information Sources*

41 The following databases will be searched: MEDLINE via Ovid (biomedical sciences, 1946-
42 present), EMBASE via Ovid (biomedical sciences, 1947-present), CINAHL (nursing and allied
43 health, 1981-present), Scopus (multidisciplinary, 1823-present), Web of Science Core
44 Collection (multidisciplinary, 1900-present), PubMed Central, and Google Scholar.
45
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47 Grey literature searches will include ProQuest Dissertations and Theses, ClinicalTrials.gov, and
48 the Cochrane Register of Controlled Trials (CENTRAL).
49

50 Recommendations and guidelines from websites of professional organizations for
51 otorhinolaryngologists and speech-language pathologists will be included. Textbooks from
52 the field of otorhinolaryngology and speech-language pathology on the assessment of voice
53 will be hand searched for relevant information on tasks.
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57 *Outcomes*

58 The primary outcome measure of this review is the identification of different vocal tasks being
59 used for acoustic and/or auditory perceptual analysis of voice for discriminating individuals
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3 with voice disorders from those without. The additional outcome measures include
4 sensitivity, specificity, and accuracy of the identified vocal tasks in discriminating individuals
5 with and without voice disorders and comparing their values.
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9 *Search strategy*

10 In the first step, a preliminary search was conducted on websites of professional
11 organizations, textbooks in voice and laryngology, PubMed, and key review papers^{6,19,20} to
12 identify a list of concepts and key terms. The search was reviewed by an experienced
13 Medicine and Health Academic Liaison Librarian at The University of Sydney. The identified
14 concepts and key terms were refined and finalized based on a discussion between all the
15 authors. This first step was carried out to plan for the subsequent steps in the review.
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19 In the second step, a comprehensive search will be conducted using the finalized
20 concepts and keywords across the relevant electronic databases. The finalized concepts and
21 keywords will be adapted to develop search strategies for each database in consultation with
22 the librarian. An example of one of the search strategies has been included as Appendix 1.
23
24

25 Studies and relevant guidelines that meet the inclusion criteria will be uploaded into
26 Covidence²¹ (Covidence systematic review software, Veritas Health innovation, Melbourne,
27 Australia) for screening after removal of duplicates. The titles and abstracts will be screened
28 by two independent reviewers based on the eligibility criteria. The full text of the studies that
29 meet the eligibility criteria will be retrieved and reviewed by two independent reviewers to
30 determine eligibility for further inclusion. The reasons for excluding any studies at this stage
31 will be noted and reported in the review. Any disagreements will be resolved by involving a
32 third reviewer. The reference lists of the finalized articles will be inspected for any other
33 additional studies.
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37 The websites of the professional organizations will be scrutinized by the first author
38 (DG) to identify any information pertaining to clinical guidelines and recommendations for
39 voice assessment. Only websites that contain relevant information will be included for further
40 analysis. Thirty percent of the websites will be reviewed by another author (AC) to ascertain
41 reliability. Any discrepancies will be resolved through discussions between DG and AC.
42 Textbooks from the field of otorhinolaryngology and speech-language pathology on the
43 assessment of voice will be hand searched for relevant information on tasks for acoustic
44 and/or auditory perceptual analysis.
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50 *Data extraction and data management*

51 Data will be extracted by at least two independent reviewers from the selected studies. The
52 full text of the selected articles will be uploaded onto the Covidence systematic review
53 platform. The data extraction tool will include details related to the study population,
54 participant details, tasks, contexts, methodology and key findings relevant to the review
55 question. The template for data extraction has been provided as Appendix 2.
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58 The data extraction tool will be trialled on 10% of the included studies to ensure all
59 the relevant information is being extracted. Any disagreements will be resolved through
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3 discussion or by involving a third reviewer. The data will be extracted, entered and
4 maintained on a Microsoft Excel spreadsheet.
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7 *Risk of bias (quality) assessment*

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9 The methodological quality of the included studies will be appraised using the relevant Critical
10 Appraisal Tool by JBI, such as Checklist for Diagnostic test accuracy studies²² and Checklist for
11 Analytical Cross-sectional studies²³. The clinical guidelines and recommendations for voice
12 assessment by professional bodies will be appraised using the RIGHT checklist.²⁴ The JBI
13 critical appraisal checklist for text and opinion papers²⁵ will also be used for clinical guidelines
14 and recommendations from websites of professional organizations and textbooks.
15
16

17 *Data synthesis*

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19 The findings will be presented in the form of an information matrix with the tasks identified
20 tabulated against the nature of the task, vocal function dimensions being tested, acoustic
21 and/or auditory perceptual analysis parameters being obtained, and their accuracy,
22 sensitivity, and specificity in identifying individuals with voice problems. Specific tasks (if any)
23 that are used or recommended for specific conditions/populations will be identified. If some
24 of the studies are homogeneous in terms of their design, a meta-analysis using suitable
25 statistics may be conducted depending on the distribution of data.
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29 **ETHICS AND DISSEMINATION**

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31 Formal ethics approval is not required as the review will analyse secondary data and not use
32 any data from individual patients. The results of the review will be presented at national and
33 international scientific meetings as well as published in reputed peer-reviewed scientific
34 journal.
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AUTHORS' CONTRIBUTIONS

All authors have made contributed to the development of the protocol. DG is the lead investigator and has written the protocol. AC, DDN, and CM have provided critical comments and modifications to the drafts of the protocol.

FUNDING STATEMENT

The research is being funded by the Doctor Liang Voice Program at the University of Sydney.

COMPETING INTERESTS STATEMENT

None declared

Appendix 1: Search strategy

The following search concepts and terms will be adapted to suit each of electronic database, with limits of year 1930 to present day and English language.

The search strategy will include 'vocal tasks' AND 'assessment' AND 'voice problem'

CONCEPT AREA	RELATED SEARCH TERMS
Vocal tasks	<ul style="list-style-type: none"> – voice task* – vocal task* – phonat* – sustained vowel* – prolonged vowel* – reading passage* – rainbow passage* – grandfather passage* – zoo passage* – consensus auditory perceptual evaluation – CAPE-V sentence* – CAPE-V phrase* – continuous speech – counting number* – loudness (OR volume OR amplitude OR intensity) range – dynamic range – pitch range – pitch glide – plosive fricative nasal – sing (OR song OR sung) – singing scale*OR musical scale* – diadochokinetic rate* – alternative motion rate OR sequential motion rate
Assessment	<ul style="list-style-type: none"> – voice assessment (OR evaluation OR analysis OR measure*) – instrumental OR objective – subjective – acoustic assessment (evaluation OR analysis OR measure*) – auditory perceptual – time domain* – frequency domain* – fundamental frequency – perturbation – glottal noise – harmonic – fundamental – voice spectrum – spectral tilt – spectral slope*

	<ul style="list-style-type: none"> – formant – energy ratio* – cepstrum – non-linear voice acoustic – voice acoustic index – linear prediction* – acoustic prediction* – voice discrimination* – voice discriminant analys* – grade – roughness – breathiness – quality – strain – asthenia
Voice disorders	<ul style="list-style-type: none"> – voice disorder* – voice problem* – voice pathology – pathological voice – aphonia – dysphonia – hoarseness

Appendix 2: Data extraction templates

Data extraction template for studies identified from electronic databases	
Study details and study characteristics	
Citation details: (Authors, publication year, journal name, volume, pages)	
Country where study was carried out,	
Study design	
Participant details (Age, gender distribution, setting, diagnosis)	
Details extracted from the study	
Acoustic analysis instrument/software (Name, specifications)	
Auditory-perceptual evaluation procedure (Rating scale)	
Task (Instructions, type – habitual/performance-based)	
References for the tasks	

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4	Recording protocol	
5	(Name, standardized/non-standardized, any other	
6	specifications)	
7	Dimensions of voice being assessed	
8	(Quality, intensity, frequency, time, consistency, endurance)	
9	Measures/parameters being measured	
10	Information on accuracy, sensitivity, and specificity	
11	Key findings relevant to the review	
12		
13	Data extraction template for guidelines and recommendations of professional organizations	
14		
15		
16	Details related to website	
17	(Name of organization, type of organization (SLP/ENT),	
18	website URL, contact details)	
19	Voice assessment information	
20	(Available or not available, if available – voice assessment	
21	protocol recommended)	
22	Acoustic analysis details	
23	(instrument/software specifications, tasks, recording	
24	protocol, acoustic measures/parameters being measured,	
25	Auditory-perceptual evaluation procedure	
26	(rating scale, tasks, parameters)	
27	Any other relevant information	
28		
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31	Data extraction template for textbooks	
32		
33	Details related to textbook	
34	(Name, author, edition, publishers, chapter name, authors	
35	for the chapter)	
36	Voice assessment information	
37	(Available or not available, if available – voice assessment	
38	protocol discussed)	
39	Acoustic analysis details	
40	(instrument/software specifications, tasks, recording	
41	protocol, acoustic measures/parameters being measured)	
42	Auditory-perceptual evaluation procedure	
43	(rating scale, tasks, parameters)	
44	Any other relevant information	
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Appendix 1: PRISMA-P CHECKLIST

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

Section topic	and Item No	Checklist item	Page no
Administrative Information			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
	Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
	Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	-
Support:			
Sources	5a	Indicate sources of financial or other support for the review	8
Sponsor	5b	Provide name for the review funder and/or sponsor	8
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	8
Introduction			
Rationale	6	Describe the rationale for the review in the context of what is already known	2-3
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	1,3
Methods			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years	3-4

		considered, language, publication status) to be used as criteria for eligibility for the review	
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	4
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	9-10
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	5-6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	5
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	5
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	4-5
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	4-5
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	6
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	6
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2 , Kendall's τ)	-
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	-
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	6
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	6
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	6

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Manuscripts

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3 **Vocal tasks for acoustic and auditory perceptual analysis for discriminating individuals**
4 **with and without voice disorders: A systematic review protocol**
5

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21 **ABSTRACT**
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23 ***Objective:***
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25 The primary objective of the present systematic review is to:
26

27 1) identify the current vocal tasks being used for acoustic and/or auditory perceptual analysis
28 to differentiate between individuals with and without voice disorders
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30 The secondary objectives are to:
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32 2) evaluate the evidence of the sensitivity, specificity and accuracy of those vocal tasks for
33 acoustic and/or auditory perceptual analysis in discriminating the individuals with voice
34 disorders from those without.
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36 3) compare the values between the vocal tasks in discriminating individuals with voice
37 disorders from those without.
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40 ***Method and analysis:***
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42 We search the following electronic databases: MEDLINE, EMBASE, CINAHL, Scopus, Web of
43 Science Core Collection, PubMed Central, and Google Scholar. Grey literature searches will
44 include ProQuest Dissertations and Theses, ClinicalTrials.gov, and the Cochrane Register of
45 Controlled Trials. Websites of professional organizations and textbooks will be hand searched
46 for relevant information related to the research question. Study screening, selection and data
47 extraction will be conducted independently by two reviewers. Any disagreements will be
48 resolved by discussion or by involving a third reviewer.
49

50 The methodological quality of the included studies will be appraised using the relevant Critical
51 Appraisal Tools by JBI. The clinical guidelines and recommendations for voice assessment by
52 professional bodies will be appraised using the RIGHT checklist. The findings will be presented
53 in the form of an information matrix with the tasks identified tabulated against the nature of
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3 the task, dimensions being tested, and their accuracy, sensitivity, and specificity in identifying
4 individuals with voice problems.
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6 ***Ethics and dissemination:***

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8 Formal ethics approval is not required. The findings will be presented at national and
9 international conferences and published in a peer-reviewed journal.
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12 **PROSPERO registration number:** PROSPERO 2023 CRD42023431634
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14 15 16 **Strengths and limitations of this study**

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- 19 • The systematic review will follow a robust procedure to identify the tasks from
20 scientific articles, textbooks, as well as recommendations and guidelines by
21 professional organizations for otorhinolaryngologists and speech-language
22 pathologists.
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 - 24 • This systematic review will identify the different tasks being used for acoustic and/or
25 auditory perceptual analysis to differentiate individuals with voice disorders from
26 those without. Further, it will provide evidence of the sensitivity, specificity and
27 accuracy of those vocal tasks.
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 - 29 • The findings of the review will be presented as an information matrix that will be a
30 useful evidence-based guide for task selection in acoustic and/or auditory perceptual
31 analysis.
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 - 33 • Only articles written in the English language will be included in the review.
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38 **INTRODUCTION**

39
40 An individual is suspected to have a voice disorder when their voice pitch, quality or loudness
41 differs compared to others of the same age, gender, ethnic background, or geographical
42 location[1]. The presence of voice disorders can impact communication and have a negative
43 impact on the overall well-being of the individual and their quality of life [2,3]. Delays in
44 referrals and increased wait times increase the burden on healthcare systems whilst early
45 assessment, diagnosis and access to treatment can help in reducing healthcare costs [4].
46 Voice disorders can be broadly classified into Organic Voice Disorders, Functional
47 (psychogenic) voice disorders and Muscle Tension Voice Disorder. The Organic Voice
48 Disorders include voice disorders that include pathological changes in structure and/or
49 movement of the larynx. These are further subclassified into structural, inflammatory, neuro-
50 muscular and trauma. The Functional (psychogenic) voice disorders include loss of voluntary
51 motor control over and/or loss of self-regulation for initiation of voice and include
52 aphonia/dysphonia and puberphonia. The Muscle Tension Voice Disorders include a visible
53 and palatable tension of laryngeal musculature and muscular imbalance. These include
54 primary, secondary and adaptive [5].
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3 Research in voice and laryngology has recommended multidimensional assessments
4 using a comprehensive test battery when assessing a voice disorder. These include case
5 history, laryngeal imaging, auditory-perceptual evaluation, acoustic analysis, aerodynamic
6 analysis, and patient-reported outcome measures regarding the impact of the voice disorder
7 on the patient's life [6-8].
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10
11 Acoustic analysis of voice provides objective or quantifiable measures in relation to
12 the vocal function, loudness, pitch, and quality. It includes non-invasive procedures and are
13 commonly used in clinical assessment for detecting the presence or absence of a voice
14 disorder [7]. Protocols are available for functional assessment of voice [6] while recent
15 consensus documents provide specific recommendations on data acquisition, technical
16 specifications, examination procedures and tasks that can be used for acoustic analysis [8].
17 Guidelines based on scientific literature have also been suggested for recording and analysis
18 in specific conditions such as dysarthria of movement disorders [9] and muscle tension
19 dysphonia [10]. Studies on acoustic analysis of voice have proposed using wide variety of tasks
20 ranging from sustained phonation, variations in sustained phonation with respect to pitch and
21 intensity, reading sentences or passages, or counting numbers [6,8,9,11]. Auditory perceptual
22 evaluation of voice is often considered the gold standard and refers to the method of rating
23 a voice and its associated qualities by listening to it. Auditory perceptual evaluation is
24 subjective and influenced by several factors related to the listener, such as their experience,
25 bias, stimuli, and rating procedure being used [12-14].
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33 Studies have been carried out to identify the optional tasks for the acoustic and/or
34 auditory perceptual analysis of voice [15-17]. However, we do not have a comprehensive
35 understanding about the vocal tasks being used for acoustic and/or auditory perceptual
36 analysis to differentiate between individuals with and without voice disorders. A preliminary
37 search was conducted on Medline, PROSPERO, JBI Evidence synthesis and Google Scholar and
38 no existing reviews or registered protocols on tasks for acoustic and/or auditory perceptual
39 analysis were identified.
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43 **Review questions**

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45 What are the current vocal tasks being used for acoustic and/or auditory perceptual
46 analysis to differentiate between individuals with and without voice disorders?
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49 What is the available evidence of the sensitivity, specificity, and accuracy of those vocal tasks
50 for acoustic and/or auditory perceptual analysis in discriminating the individuals with and
51 without voice disorders? Are there differences in the vocal task values between individuals
52 with and without voice disorders?
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57 **METHODS AND ANALYSIS**

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3 The systematic review protocol follows methodology suggested by the Preferred Reporting
4 Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) [18]. The completed
5 PRISMA-P checklist has been provided. The protocol has been published in PROSPERO
6 International Prospective Register of Systematic Reviews database PROSPERO 2023
7 CRD42023431634. The final review will be reported as per the Preferred Reporting Items for
8 Systematic review and Meta-Analysis (PRISMA) statement [19].
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12 Formal activities for this review have commenced in July 2023. The analysis and writing
13 should conclude by June 2024.
14

15 Patient and public involvement

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17 The present protocol and the subsequent review are based on published data. Thus, no approval
18 from any ethics committee or consent form patients is required. The results will be disseminated
19 through a peer-reviewed publication.
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23 **Study selection Criteria**

24 *Participants*

25 Studies comparing individuals with and without voice disorders using acoustic and/or
26 auditory perceptual evaluation of voice will be included. No limits will be placed upon neither
27 the age range, gender, or language of the participants nor their geographical region or
28 ethnicity.
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33 *Concept*

34 *Inclusion*

35 Studies in human subjects exploring vocal tasks for acoustic and/or auditory perceptual
36 analysis of voice across clinical and laboratory-based settings will be considered. Only studies
37 that compare individuals with and without voice problems will be considered. Only studies
38 that have performed a statistical analysis, such as sensitivity or specificity, to discriminate
39 between the two groups will be included.
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45 *Exclusion*

46 Studies using animal models involving users of alaryngeal speech, artificial or machine-
47 generated tones will not be included. Studies evaluating effectiveness of any interventions or
48 therapeutic approaches will not be included. Studies in individuals with any speech sound
49 disorders or articulation disorders will not be included.
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53 *Study design*

54 No filters for study design will be used.
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57 *Context*

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3 The review will include relevant data from all geographical locations and settings. All studies
4 published in the English language from 1930 onwards will be included. The year 1930 was
5 selected as it is the year in which formal studies on voice were first reported [7].
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8 9 *Information Sources*

10 The following databases will be searched: MEDLINE via Ovid (biomedical sciences, 1946-
11 present), EMBASE via Ovid (biomedical sciences, 1947-present), CINAHL (nursing and allied
12 health, 1981-present), Scopus (multidisciplinary, 1823-present), Web of Science Core
13 Collection (multidisciplinary, 1900-present), PubMed Central, and Google Scholar.

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16 Grey literature searches will include ProQuest Dissertations and Theses, ClinicalTrials.gov, and
17 the Cochrane Register of Controlled Trials (CENTRAL).

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19 Recommendations and guidelines from websites of professional organizations for
20 otorhinolaryngologists and speech-language pathologists will be included. Textbooks from
21 the field of otorhinolaryngology and speech-language pathology on the assessment of voice
22 will be hand searched for relevant information on tasks.
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25 26 *Outcomes*

27 The primary outcome measure of this review is the identification of different vocal tasks being
28 used for acoustic and/or auditory perceptual analysis of voice for discriminating individuals
29 with voice disorders from those without. The additional outcome measures include
30 sensitivity, specificity, and accuracy of the identified vocal tasks in discriminating individuals
31 with and without voice disorders and comparing their values.
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34 35 36 *Search strategy*

37 In the first step, a preliminary search was conducted on websites of professional
38 organizations, textbooks in voice and laryngology, PubMed, and key review papers [5,7,20] to
39 identify a list of concepts and key terms. The search was reviewed by an experienced
40 Medicine and Health Academic Liaison Librarian at The University of Sydney. The identified
41 concepts and key terms were refined and finalized based on a discussion between all the
42 authors. This first step was carried out to plan for the subsequent steps in the review.
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45 In the second step, a comprehensive search will be conducted using the finalized
46 concepts and keywords across the relevant electronic databases. The finalized concepts and
47 keywords will be adapted to develop search strategies for each database in consultation with
48 the librarian. An example of one of the search strategies has been included as Appendix 1.
49

50
51 Studies and relevant guidelines that meet the inclusion criteria will be uploaded into
52 Covidence [21] (Covidence systematic review software, Veritas Health innovation,
53 Melbourne, Australia) for screening after removal of duplicates. The titles and abstracts will
54 be screened by two independent reviewers based on the eligibility criteria. The full text of the
55 studies that meet the eligibility criteria will be retrieved and reviewed by two independent
56 reviewers to determine eligibility for further inclusion. The reasons for excluding any studies
57 at this stage will be noted and reported in the review. Any disagreements will be resolved by
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3 involving a third reviewer. The reference lists of the finalized articles will be inspected for any
4 other additional studies.
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6 The websites of the professional organizations will be scrutinized by the first author
7 (DG) to identify any information pertaining to clinical guidelines and recommendations for
8 voice assessment. Only websites that contain relevant information will be included for further
9 analysis. Thirty percent of the websites will be reviewed by another author (AC) to ascertain
10 reliability. Any discrepancies will be resolved through discussions between DG and AC.
11 Textbooks from the field of otorhinolaryngology and speech-language pathology on the
12 assessment of voice will be hand searched for relevant information on tasks for acoustic
13 and/or auditory perceptual analysis.
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18 *Data extraction and data management*

19 Data will be extracted by at least two independent reviewers from the selected studies. The
20 full text of the selected articles will be uploaded onto the Covidence systematic review
21 platform. The data extraction tool will include details related to the study population,
22 participant details, tasks, contexts, methodology and key findings relevant to the review
23 question. The template for data extraction has been provided as Appendix 2.
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27 The data extraction tool will be trialled on 10% of the included studies to ensure all
28 the relevant information is being extracted. Any disagreements will be resolved through
29 discussion or by involving a third reviewer. The data will be extracted, entered and
30 maintained on a Microsoft Excel spreadsheet.
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34 *Risk of bias (quality) assessment*

35 The methodological quality of the included studies will be appraised using the relevant Critical
36 Appraisal Tool by JBI, such as Checklist for Diagnostic test accuracy studies [22] and Checklist
37 for Analytical Cross-sectional studies [23]. The clinical guidelines and recommendations for
38 voice assessment by professional bodies will be appraised using the RIGHT checklist [24]. The
39 JBI critical appraisal checklist for text and opinion papers [25] will also be used for clinical
40 guidelines and recommendations from websites of professional organizations and
41 textbooks.
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46 *Data synthesis*

47 The findings will be presented in the form of an information matrix with the tasks identified
48 tabulated against the nature of the task, vocal function dimensions being tested, acoustic
49 and/or auditory perceptual analysis parameters being obtained, and their accuracy,
50 sensitivity, and specificity in identifying individuals with voice problems. Specific tasks (if any)
51 that are used or recommended for specific conditions/populations will be identified. If some
52 of the studies are homogeneous in terms of their design, a meta-analysis using suitable
53 statistics may be conducted depending on the distribution of data.
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58 **ETHICS AND DISSEMINATION**

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3 Formal ethics approval is not required as the review will analyse secondary data and not use
4 any data from individual patients. The results of the review will be presented at national and
5 international scientific meetings as well as published in reputed peer-reviewed scientific
6 journal.
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10 [Checklist_for_Text_and_Opinion2017_0.pdf](https://jbi.global/sites/default/files/2019-05/JBI_Critical_Appraisal-Checklist_for_Text_and_Opinion2017_0.pdf)
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17 **AUTHORS' CONTRIBUTIONS**

18 All authors have made contributed to the development of the protocol. DG is the lead
19 investigator and has written the protocol. AC, DDN, and CM have provided critical comments
20 and modifications to the drafts of the protocol.
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25 **FUNDING STATEMENT**

26 The research is being funded by the Doctor Liang Voice Program at the University of Sydney.
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30 **COMPETING INTERESTS STATEMENT**

31 None declared
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Appendix 1: Search strategy

The following search concepts and terms will be adapted to suit each of electronic database, with limits of year 1930 to present day and English language.

The search strategy will include 'vocal tasks' AND 'assessment' AND 'voice problem'

CONCEPT AREA	RELATED SEARCH TERMS
Vocal tasks	<ul style="list-style-type: none"> – voice task* – vocal task* – phonat* – sustained vowel* – prolonged vowel* – reading passage* – rainbow passage* – grandfather passage* – zoo passage* – consensus auditory perceptual evaluation – CAPE-V sentence* – CAPE-V phrase* – continuous speech – counting number* – loudness (OR volume OR amplitude OR intensity) range – dynamic range – pitch range – pitch glide – plosive fricative nasal – sing (OR song OR sung) – singing scale*OR musical scale* – diadochokinetic rate* – alternative motion rate OR sequential motion rate
Assessment	<ul style="list-style-type: none"> – voice assessment (OR evaluation OR analysis OR measure*) – instrumental OR objective – subjective – acoustic assessment (evaluation OR analysis OR measure*) – auditory perceptual – time domain* – frequency domain* – fundamental frequency – perturbation – glottal noise – harmonic – fundamental

	<ul style="list-style-type: none"> – voice spectrum – spectral tilt – spectral slope* – formant – energy ratio* – cepstrum – non-linear voice acoustic – voice acoustic index – linear prediction* – acoustic prediction* – voice discrimination* – voice discriminant analys* – grade – roughness – breathiness – quality – strain – asthenia
Voice disorders	<ul style="list-style-type: none"> – voice disorder* – voice problem* – voice pathology – pathological voice – aphonia – dysphonia – hoarseness

Appendix 2: Data extraction templates

Data extraction template for studies identified from electronic databases	
Study details and study characteristics	
Citation details: (Authors, publication year, journal name, volume, pages)	
Country where study was carried out,	
Study design	
Participant details (Age, gender distribution, setting, diagnosis)	
Details extracted from the study	
Acoustic analysis instrument/software (Name, specifications)	
Auditory-perceptual evaluation procedure (Rating scale)	

1	Task	
2	(Instructions, type – habitual/performance-based)	
3	References for the tasks	
4	Recording protocol	
5	(Name, standardized/non-standardized, any other	
6	specifications)	
7	Dimensions of voice being assessed	
8	(Quality, intensity, frequency, time, consistency, endurance)	
9	Measures/parameters being measured	
10	Information on accuracy, sensitivity, and specificity	
11	Key findings relevant to the review	
12	Data extraction template for guidelines and recommendations of professional organizations	
13	Details related to website	
14	(Name of organization, type of organization (SLP/ENT),	
15	website URL, contact details)	
16	Voice assessment information	
17	(Available or not available, if available – voice assessment	
18	protocol recommended)	
19	Acoustic analysis details	
20	(instrument/software specifications, tasks, recording	
21	protocol, acoustic measures/parameters being measured,	
22	Auditory-perceptual evaluation procedure	
23	(rating scale, tasks, parameters)	
24	Any other relevant information	
25	Data extraction template for textbooks	
26	Details related to textbook	
27	(Name, author, edition, publishers, chapter name, authors	
28	for the chapter)	
29	Voice assessment information	
30	(Available or not available, if available – voice assessment	
31	protocol discussed)	
32	Acoustic analysis details	
33	(instrument/software specifications, tasks, recording	
34	protocol, acoustic measures/parameters being measured)	
35	Auditory-perceptual evaluation procedure	
36	(rating scale, tasks, parameters)	
37	Any other relevant information	

Appendix 1: PRISMA-P CHECKLIST

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

Section topic	and Item No	Checklist item	Page no
Administrative Information			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
	Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
	Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	-
Support:			
Sources	5a	Indicate sources of financial or other support for the review	8
Sponsor	5b	Provide name for the review funder and/or sponsor	8
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	8
Introduction			
Rationale	6	Describe the rationale for the review in the context of what is already known	2-3
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	1,3
Methods			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years	3-4

		considered, language, publication status) to be used as criteria for eligibility for the review	
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	4
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	9-10
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	5-6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	5
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	5
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	4-5
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	4-5
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	6
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	6
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2 , Kendall's τ)	-
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	-
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	6
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	6
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	6

BMJ Open

Vocal tasks for acoustic and auditory perceptual analysis for discriminating individuals with and without voice disorders: A systematic review protocol

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Manuscripts

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3 **Vocal tasks for acoustic and auditory perceptual analysis for discriminating individuals**
4 **with and without voice disorders: A systematic review protocol**
5

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21 **ABSTRACT**
22

23 ***Objective:***
24

25 The primary objective of the present systematic review is to:
26

27 1) identify the current vocal tasks being used for acoustic and/or auditory perceptual analysis
28 to differentiate between individuals with and without voice disorders
29

30 The secondary objectives are to:
31

32 2) evaluate the evidence of the sensitivity, specificity, and accuracy of those vocal tasks for
33 acoustic and/or auditory perceptual analysis in discriminating the individuals with voice
34 disorders from those without.
35

36 3) compare the values between the vocal tasks in discriminating individuals with voice
37 disorders from those without.
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41 ***Method and analysis:***
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43 We search the following electronic databases: MEDLINE, EMBASE, CINAHL, Scopus, Web of
44 Science Core Collection, PubMed Central, and Google Scholar. Grey literature searches will
45 include ProQuest Dissertations and Theses, ClinicalTrials.gov, and the Cochrane Register of
46 Controlled Trials. Websites of professional organizations and textbooks will be hand searched
47 for relevant information related to the research question. Study screening, selection and data
48 extraction will be conducted independently by two reviewers. Any disagreements will be
49 resolved by discussion or by involving a third reviewer.
50

51 The methodological quality of the included studies will be appraised using the relevant Critical
52 Appraisal Tools by JBI. The clinical guidelines and recommendations for voice assessment by
53 professional bodies will be appraised using the RIGHT checklist. The findings will be presented
54 in the form of an information matrix with the tasks identified tabulated against the nature of
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3 the task, dimensions being tested, and their accuracy, sensitivity, and specificity in identifying
4 individuals with voice problems.
5

6 ***Ethics and dissemination:***

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8 Formal ethics approval is not required. The findings will be presented at national and
9 international conferences and published in a peer-reviewed journal.
10
11

12 **PROSPERO registration number:** PROSPERO 2023 CRD42023431634
13

14 **Keywords**

15
16 Vocal tasks; acoustic analysis; auditory perceptual analysis; voice; voice disorder; systematic
17 review
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19 **Strengths and limitations of this study**

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21
- 22 • The systematic review will follow a robust procedure to identify the tasks from
23 scientific articles, textbooks, as well as recommendations and guidelines by
24 professional organizations for otorhinolaryngologists and speech-language
25 pathologists.
26
 - 27 • This systematic review will identify the different tasks being used for acoustic and/or
28 auditory perceptual analysis to differentiate individuals with voice disorders from
29 those without. Further, it will provide evidence of the sensitivity, specificity and
30 accuracy of those vocal tasks.
31
 - 32 • The findings of the review will be presented as an information matrix that will be a
33 useful evidence-based guide for task selection in acoustic and/or auditory perceptual
34 analysis.
35
 - 36 • Only articles written in the English language will be included in the review.
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42 **INTRODUCTION**

43
44 An individual is suspected to have a voice disorder when their voice pitch, quality or loudness
45 differs compared to others of the same age, gender, ethnic background, or geographical
46 location [1]. The presence of voice disorders can impact communication and have a negative
47 impact on the overall well-being of the individual and their quality of life [2,3]. Delays in
48 referrals and increased wait times increase the burden on healthcare systems whilst early
49 assessment, diagnosis and access to treatment can help in reducing healthcare costs [4].
50 Voice disorders can be broadly classified into Organic Voice Disorders, Functional
51 (psychogenic) voice disorders and Muscle Tension Voice Disorder. The Organic Voice
52 Disorders include voice disorders that include pathological changes in structure and/or
53 movement of the larynx. These are further subclassified into structural, inflammatory, neuro-
54 muscular and trauma. The Functional (psychogenic) voice disorders include loss of voluntary
55 motor control over and/or loss of self-regulation for initiation of voice and include
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aphonia/dysphonia and puberphonia. The Muscle Tension Voice Disorders include a visible and palpable tension of laryngeal musculature and muscular imbalance. These include primary, secondary, and adaptive [5].

Research in voice and laryngology has recommended multidimensional assessments using a comprehensive test battery when assessing a voice disorder. These include case history, laryngeal imaging, auditory-perceptual evaluation, acoustic analysis, aerodynamic analysis, and patient-reported outcome measures regarding the impact of the voice disorder on the patient's life [6-8].

Acoustic analysis of voice provides objective or quantifiable measures in relation to the vocal function, loudness, pitch, and quality. It includes non-invasive procedures and are commonly used in clinical assessment for detecting the presence or absence of a voice disorder [7]. Protocols are available for functional assessment of voice [6] while recent consensus documents provide specific recommendations on data acquisition, technical specifications, examination procedures and tasks that can be used for acoustic analysis [8]. Guidelines based on scientific literature have also been suggested for recording and analysis in specific conditions such as dysarthria of movement disorders [9] and muscle tension dysphonia [10]. Studies on acoustic analysis of voice have proposed using wide variety of tasks ranging from sustained phonation, variations in sustained phonation with respect to pitch and intensity, reading sentences or passages, or counting numbers [6,8,9,11]. Auditory perceptual evaluation of voice is often considered the gold standard and refers to the method of rating a voice and its associated qualities by listening to it. Auditory perceptual evaluation is subjective and influenced by several factors related to the listener, such as their experience, bias, stimuli, and rating procedure being used [12-14].

Previous systematic reviews and meta-analysis in conditions such as amyotrophic lateral sclerosis [15], dysarthria [16], and stroke [16,17] have provided valuable insight to responsible healthcare professionals. The findings of these reviews can be utilized for practical and clinical scenarios that aid better assessment and treatment outcomes while managing these conditions. As there is a range of vocal tasks available, the findings of the present review provide a detailed overview of the different tasks and their sensitivity and specificity in identifying individuals with voice problems. This will also help the professionals in selecting specific tasks that are evidence based and better suited for their clinical and research requirements.

Studies have been carried out to identify the optional tasks for the acoustic and/or auditory perceptual analysis of voice [18-20]. However, we do not have a comprehensive understanding about the vocal tasks being used for acoustic and/or auditory perceptual analysis to differentiate between individuals with and without voice disorders. A preliminary search was conducted on Medline, PROSPERO, JBI Evidence synthesis and Google Scholar and

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3 no existing reviews or registered protocols on tasks for acoustic and/or auditory perceptual
4 analysis were identified.
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6 **Review questions**

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9 What are the current vocal tasks being used for acoustic and/or auditory perceptual
10 analysis to differentiate between individuals with and without voice disorders?
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12 What is the available evidence of the sensitivity, specificity, and accuracy of those vocal tasks
13 for acoustic and/or auditory perceptual analysis in discriminating the individuals with and
14 without voice disorders? Are there differences in the vocal task values between individuals
15 with and without voice disorders?
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20 **METHODS AND ANALYSIS**

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22 The systematic review protocol follows methodology suggested by the Preferred Reporting
23 Items for Systematic review and Meta-Analysis Protocols (PRISMA-P) [21]. The completed
24 PRISMA-P checklist has been provided. The protocol has been published in PROSPERO
25 International Prospective Register of Systematic Reviews database PROSPERO 2023
26 CRD42023431634. The final review will be reported as per the Preferred Reporting Items for
27 Systematic review and Meta-Analysis (PRISMA) statement [22].
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32 Formal activities for this review have commenced in July 2023. The analysis and writing should
33 conclude by June 2024.
34

35 Patient and public involvement

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37 None. The present protocol and the subsequent review are based on published data. Thus,
38 no approval from any ethics committee or consent form patients is required. The results will
39 be disseminated through a peer-reviewed publication.
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44 **Study selection Criteria**

45 *Participants*

46 Studies comparing individuals with and without voice disorders using acoustic and/or
47 auditory perceptual evaluation of voice will be included. No limits will be placed upon neither
48 the age range, gender, or language of the participants nor their geographical region or
49 ethnicity.
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54 *Concept*

55 *Inclusion*

56 Studies in human subjects exploring vocal tasks for acoustic and/or auditory perceptual
57 analysis of voice across clinical and laboratory-based settings will be considered. Only studies
58 that compare individuals with and without voice problems will be considered. Only studies
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3 that have performed a statistical analysis, such as sensitivity or specificity, to discriminate
4 between the two groups will be included.
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6 *Exclusion*

7 Studies using animal models involving users of alaryngeal speech, artificial or machine-
8 generated tones will not be included. Studies evaluating effectiveness of any interventions or
9 therapeutic approaches will not be included. Studies in individuals with any speech sound
10 disorders or articulation disorders will not be included.
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14 *Study design*

15 No filters for study design will be used.
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19 *Context*

20 The review will include relevant data from all geographical locations and settings. All studies
21 published in the English language from 1930 onwards will be included. The year 1930 was
22 selected as it is the year in which formal studies on voice were first reported [7].
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26 *Information Sources*

27 The following databases will be searched: MEDLINE via Ovid (biomedical sciences, 1946-
28 present), EMBASE via Ovid (biomedical sciences, 1947-present), CINAHL (nursing and allied
29 health, 1981-present), Scopus (multidisciplinary, 1823-present), Web of Science Core
30 Collection (multidisciplinary, 1900-present), PubMed Central, and Google Scholar.
31

32 Grey literature searches will include ProQuest Dissertations and Theses, ClinicalTrials.gov, and
33 the Cochrane Register of Controlled Trials (CENTRAL).
34

35 Recommendations and guidelines from websites of professional organizations for
36 otorhinolaryngologists and speech-language pathologists will be included. Textbooks from
37 the field of otorhinolaryngology and speech-language pathology on the assessment of voice
38 will be hand searched for relevant information on tasks.
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42 *Outcomes*

43 The primary outcome measure of this review is the identification of different vocal tasks being
44 used for acoustic and/or auditory perceptual analysis of voice for discriminating individuals
45 with voice disorders from those without. The additional outcome measures include
46 sensitivity, specificity, and accuracy of the identified vocal tasks in discriminating individuals
47 with and without voice disorders and comparing their values.
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52 *Search strategy*

53 In the first step, a preliminary search was conducted on websites of professional
54 organizations, textbooks in voice and laryngology, PubMed, and key review papers [5,7,23] to
55 identify a list of concepts and key terms. The search was reviewed by an experienced
56 Medicine and Health Academic Liaison Librarian at The University of Sydney. The identified
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3 concepts and key terms were refined and finalized based on a discussion between all the
4 authors. This first step was carried out to plan for the subsequent steps in the review.
5

6 In the second step, a comprehensive search will be conducted using the finalized
7 concepts and keywords across the relevant electronic databases. The finalized concepts and
8 keywords will be adapted to develop search strategies for each database in consultation with
9 the librarian. An example of one of the search strategies has been included as Appendix 1.
10

11 Studies and relevant guidelines that meet the inclusion criteria will be uploaded into
12 Covidence [24] (Covidence systematic review software, Veritas Health innovation,
13 Melbourne, Australia) for screening after removal of duplicates. The titles and abstracts will
14 be screened by two independent reviewers based on the eligibility criteria. The full text of the
15 studies that meet the eligibility criteria will be retrieved and reviewed by two independent
16 reviewers to determine eligibility for further inclusion. The reasons for excluding any studies
17 at this stage will be noted and reported in the review. Any disagreements will be resolved by
18 involving a third reviewer. The reference lists of the finalized articles will be inspected for any
19 other additional studies.
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24 The websites of the professional organizations will be scrutinized by the first author
25 (DG) to identify any information pertaining to clinical guidelines and recommendations for
26 voice assessment. Only websites that contain relevant information will be included for further
27 analysis. Thirty percent of the websites will be reviewed by another author (AC) to ascertain
28 reliability. Any discrepancies will be resolved through discussions between DG and AC.
29 Textbooks from the field of otorhinolaryngology and speech-language pathology on the
30 assessment of voice will be hand searched for relevant information on tasks for acoustic
31 and/or auditory perceptual analysis.
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37 *Data extraction and data management*

38 Data will be extracted by at least two independent reviewers from the selected studies. The
39 full text of the selected articles will be uploaded onto the Covidence systematic review
40 platform. The data extraction tool will include details related to the study population,
41 participant details, tasks, contexts, methodology and key findings relevant to the review
42 question. The template for data extraction has been provided as Appendix 2.
43
44

45 The data extraction tool will be trialled on 10% of the included studies to ensure all
46 the relevant information is being extracted. Any disagreements will be resolved through
47 discussion or by involving a third reviewer. The data will be extracted, entered, and
48 maintained on a Microsoft Excel spreadsheet.
49
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51 *Risk of bias (quality) assessment*

52 The methodological quality of the included studies will be appraised using the relevant Critical
53 Appraisal Tool by JBI, such as Checklist for Diagnostic test accuracy studies [25] and Checklist
54 for Analytical Cross-sectional studies [26]. The clinical guidelines and recommendations for
55 voice assessment by professional bodies will be appraised using the RIGHT checklist [27]. The
56 JBI critical appraisal checklist for text and opinion papers [28] will also be used for clinical
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3 guidelines and recommendations from websites of professional organizations and
4 textbooks.
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6 *Data synthesis*

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8 The findings will be presented in the form of an information matrix with the tasks identified
9 tabulated against the nature of the task, vocal function dimensions being tested, acoustic
10 and/or auditory perceptual analysis parameters being obtained, and their accuracy,
11 sensitivity, and specificity in identifying individuals with voice problems. Specific tasks (if any)
12 that are used or recommended for specific conditions/populations will be identified. If some
13 of the studies are homogeneous in terms of their design, a meta-analysis using suitable
14 statistics may be conducted depending on the distribution of data.
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18 **ETHICS AND DISSEMINATION**

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20 Formal ethics approval is not required as the review will analyse secondary data and not use
21 any data from individual patients. The results of the review will be presented at national and
22 international scientific meetings as well as published in reputed peer-reviewed scientific
23 journal.
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25

26 **AUTHORS' CONTRIBUTIONS**

27
28 All authors have made contributed to the development of the protocol. DG is the lead
29 investigator and has written the protocol. AC, DDN, and CM have provided critical comments
30 and modifications to the drafts of the protocol.
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34 **FUNDING STATEMENT**

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36 The research is being funded by the Doctor Liang Voice Program at the University of Sydney.
37
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39 **COMPETING INTERESTS STATEMENT**

40
41 None declared
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Appendix 1: Search strategy

The following search concepts and terms will be adapted to suit each of electronic database, with limits of year 1930 to present day and English language.

The search strategy will include 'vocal tasks' AND 'assessment' AND 'voice problem'

CONCEPT AREA	RELATED SEARCH TERMS
Vocal tasks	<ul style="list-style-type: none"> – voice task* – vocal task* – phonat* – sustained vowel* – prolonged vowel* – reading passage* – rainbow passage* – grandfather passage* – zoo passage* – consensus auditory perceptual evaluation – CAPE-V sentence* – CAPE-V phrase* – continuous speech – counting number* – loudness (OR volume OR amplitude OR intensity) range – dynamic range – pitch range – pitch glide – plosive fricative nasal – sing (OR song OR sung) – singing scale*OR musical scale* – diadochokinetic rate* – alternative motion rate OR sequential motion rate
Assessment	<ul style="list-style-type: none"> – voice assessment (OR evaluation OR analysis OR measure*) – instrumental OR objective – subjective – acoustic assessment (evaluation OR analysis OR measure*) – auditory perceptual – time domain* – frequency domain* – fundamental frequency – perturbation – glottal noise – harmonic – fundamental

	<ul style="list-style-type: none"> – voice spectrum – spectral tilt – spectral slope* – formant – energy ratio* – cepstrum – non-linear voice acoustic – voice acoustic index – linear prediction* – acoustic prediction* – voice discrimination* – voice discriminant analys* – grade – roughness – breathiness – quality – strain – asthenia
Voice disorders	<ul style="list-style-type: none"> – voice disorder* – voice problem* – voice pathology – pathological voice – aphonia – dysphonia – hoarseness

Appendix 2: Data extraction templates

Data extraction template for studies identified from electronic databases	
Study details and study characteristics	
Citation details: (Authors, publication year, journal name, volume, pages)	
Country where study was carried out,	
Study design	
Participant details (Age, gender distribution, setting, diagnosis)	
Details extracted from the study	
Acoustic analysis instrument/software (Name, specifications)	
Auditory-perceptual evaluation procedure (Rating scale)	

1	Task	
2	(Instructions, type – habitual/performance-based)	
3	References for the tasks	
4	Recording protocol	
5	(Name, standardized/non-standardized, any other	
6	specifications)	
7	Dimensions of voice being assessed	
8	(Quality, intensity, frequency, time, consistency, endurance)	
9	Measures/parameters being measured	
10	Information on accuracy, sensitivity, and specificity	
11	Key findings relevant to the review	
12	Data extraction template for guidelines and recommendations of professional organizations	
13	Details related to website	
14	(Name of organization, type of organization (SLP/ENT),	
15	website URL, contact details)	
16	Voice assessment information	
17	(Available or not available, if available – voice assessment	
18	protocol recommended)	
19	Acoustic analysis details	
20	(instrument/software specifications, tasks, recording	
21	protocol, acoustic measures/parameters being measured,	
22	Auditory-perceptual evaluation procedure	
23	(rating scale, tasks, parameters)	
24	Any other relevant information	
25	Data extraction template for textbooks	
26	Details related to textbook	
27	(Name, author, edition, publishers, chapter name, authors	
28	for the chapter)	
29	Voice assessment information	
30	(Available or not available, if available – voice assessment	
31	protocol discussed)	
32	Acoustic analysis details	
33	(instrument/software specifications, tasks, recording	
34	protocol, acoustic measures/parameters being measured)	
35	Auditory-perceptual evaluation procedure	
36	(rating scale, tasks, parameters)	
37	Any other relevant information	

Appendix 1: PRISMA-P CHECKLIST

PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) 2015 checklist: recommended items to address in a systematic review protocol

Section topic	and Item No	Checklist item	Page no
Administrative Information			
Title:			
Identification	1a	Identify the report as a protocol of a systematic review	1
	Update	1b	If the protocol is for an update of a previous systematic review, identify as such
Registration	2	If registered, provide the name of the registry (such as PROSPERO) and registration number	2
Authors:			
Contact	3a	Provide name, institutional affiliation, e-mail address of all protocol authors; provide physical mailing address of corresponding author	1
	Contributions	3b	Describe contributions of protocol authors and identify the guarantor of the review
Amendments	4	If the protocol represents an amendment of a previously completed or published protocol, identify as such and list changes; otherwise, state plan for documenting important protocol amendments	-
Support:			
Sources	5a	Indicate sources of financial or other support for the review	8
Sponsor	5b	Provide name for the review funder and/or sponsor	8
Role of sponsor or funder	5c	Describe roles of funder(s), sponsor(s), and/or institution(s), if any, in developing the protocol	8
Introduction			
Rationale	6	Describe the rationale for the review in the context of what is already known	2-3
Objectives	7	Provide an explicit statement of the question(s) the review will address with reference to participants, interventions, comparators, and outcomes (PICO)	1,3
Methods			
Eligibility criteria	8	Specify the study characteristics (such as PICO, study design, setting, time frame) and report characteristics (such as years	3-4

		considered, language, publication status) to be used as criteria for eligibility for the review	
Information sources	9	Describe all intended information sources (such as electronic databases, contact with study authors, trial registers or other grey literature sources) with planned dates of coverage	4
Search strategy	10	Present draft of search strategy to be used for at least one electronic database, including planned limits, such that it could be repeated	9-10
Study records:			
Data management	11a	Describe the mechanism(s) that will be used to manage records and data throughout the review	5-6
Selection process	11b	State the process that will be used for selecting studies (such as two independent reviewers) through each phase of the review (that is, screening, eligibility and inclusion in meta-analysis)	5
Data collection process	11c	Describe planned method of extracting data from reports (such as piloting forms, done independently, in duplicate), any processes for obtaining and confirming data from investigators	5
Data items	12	List and define all variables for which data will be sought (such as PICO items, funding sources), any pre-planned data assumptions and simplifications	4-5
Outcomes and prioritization	13	List and define all outcomes for which data will be sought, including prioritization of main and additional outcomes, with rationale	4-5
Risk of bias in individual studies	14	Describe anticipated methods for assessing risk of bias of individual studies, including whether this will be done at the outcome or study level, or both; state how this information will be used in data synthesis	6
Data synthesis	15a	Describe criteria under which study data will be quantitatively synthesised	6
	15b	If data are appropriate for quantitative synthesis, describe planned summary measures, methods of handling data and methods of combining data from studies, including any planned exploration of consistency (such as I^2 , Kendall's τ)	-
	15c	Describe any proposed additional analyses (such as sensitivity or subgroup analyses, meta-regression)	-
	15d	If quantitative synthesis is not appropriate, describe the type of summary planned	6
Meta-bias(es)	16	Specify any planned assessment of meta-bias(es) (such as publication bias across studies, selective reporting within studies)	6
Confidence in cumulative evidence	17	Describe how the strength of the body of evidence will be assessed (such as GRADE)	6